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PROCEEDINGS

OF THE

IOWA ACADEMY

OF

SCIENCES

FOR

1887, 1888, 1889.

v. 1, pt. 1

TOGETHER WITH THE CONSTITUTION, LISTS OF OFFICERS AND MEMBERS

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DES MOINES, IOWA:
January, 1890.

OFFICERS OF THE ACADEMY.

1887-1888.

President—PROF. HERBERT OSBORN.
First Vice President—PROF. J. E. TODD.
Second Vice President—PROF. T. H. McBRIDE.
Secretary-Treasurer—PROF. R. E. CALL.

Executive Council consisted of these Officers and the following persons:

PROF. H. W. PARKER,
PROF. F. M. WITTER.

1888-1889.

President—PROF. J. E. TODD.
First Vice President—PROF. F. M. WITTER.
Second Vice President—PROF. B. D. HALSTED.
Secretary-Treasurer—PROF. R. E. CALL.

The Executive Council remained unchanged.

142719

1889-1890.

President—PROF. F. M. WITTER.
First Vice President—PROF. C. C. NUTTING.
Second Vice President—PROF. C. P. GILLETTE.
Secretary-Treasurer—PROF. R. E. CALL.

The Executive Council was increased by the addition of

PROF. C. C. NUTTING.
PROF. C. P. GILLETTE.

B. E. ADAMS, PR., DES MOINES, IOWA.

FELLOWS OF THE ACADEMY.

PROF. B. D. HALSTED (I).
PROF. F. M. WITTER (I).
PROF. H. W. PARKER (I).
PROF. R. E. CALL (I).
PROF. HERBERT OSBORN (I).
PROF. J. E. TODD (I).
DR. H. S. WILLIAMS (II).
PROF. A. A. CROZIER (II).
PROF. W. J. McGEE (II).
PROF. C. P. GILLETTE (II).
PROF. C. C. NUTTING (III).
PROF. ERASMUS HAWORTH (III).
PROF. SETH E. MEEK (III).
PROF. L. H. PAMMEL (III).
PROF. C. H. GORDON (III).
PROF. F. W. MALLY (III).
PROF. A. S. HITCHCOCK (III).

The numbers in parentheses indicate the annual meeting at which the Fellow was elected.

CONSTITUTION.

SECTION I. This organization shall be known as the Iowa Academy of Science.

SEC. II. The object of the Academy shall be the encouragement of scientific work in the State of Iowa.

SEC. III. The membership of the Academy shall consist of Fellows, who shall be elected from residents of the State of Iowa, actively engaged in scientific work. Nomination by the council and assent of three-fourths of the Fellows present at any annual meeting shall be necessary to election.

SEC. IV. An entrance fee of three dollars shall be required of each Fellow, and an annual fee of one dollar, due at each annual meeting after his election. Fellows in arrears for two years and failing to respond to notification from the Secretary-Treasurer shall be dropped from the Academy roll.

SEC. V. (*a.*) The officers of the Academy shall be a President, two Vice-Presidents and a Secretary-Treasurer, to be elected at the annual meeting. Their duties shall be such as ordinarily devolve upon these officers.

(*b.*) The charter members of the Academy shall constitute the Council, together with such other Fellows as may be elected at an annual meeting of the Council by it as members thereof, provided, that at any such election two or more negative votes shall constitute a rejection of the candidate.

(*c.*) The Council shall have power to nominate Fellows, to elect members of the Council, fix time and place of meetings, to select papers for publication in the proceedings and have control of all meetings not provided for in general session. It may, by vote, delegate any or all of these powers, except the election of members of the Council to an executive committee, consisting of the officers and of three other Fellows to be elected by the Council.

SEC. VI. The Academy shall hold an annual meeting in Des Moines, commencing Thursday of the week of the State Fair. Other meetings may be called by the Council at times and places deemed advisable.

SEC. VII. All papers presented shall be the result of original investigation, but the Council may arrange for public lectures or addresses upon scientific subjects.

SEC. VIII. The Secretary-Treasurer shall each year publish the proceedings of the Academy in pamphlet (octavo) form, giving authors' abstracts of papers and, if published elsewhere, a reference to the place and date of publication; also the full text of such papers as may be designated by the Council. If published elsewhere the author shall, if practicable, publish in octavo form and deposit separates with the Secretary-Treasurer, to be permanently preserved for the use of the Academy.

SEC. IX. This constitution may be amended at any annual meeting by assent of a majority of the Fellows voting, and a majority of the Council, provided, notice of proposed amendment has been sent to all Fellows at least one month previous to the meeting, and provided that absent Fellows may deposit their votes, sealed, with the Secretary-Treasurer.

HISTORICAL NOTE.

The Iowa Academy of Science was organized on Tuesday, December 27, 1887, in response to a circular letter sent out by a committee consisting of Professors S. Calvin, T. H. McBride, L. W. Andrews, Herbert Osborn and R. E. Call.

The following named persons took part in the organization proceedings which were conducted in the parlors of the Kirkwood House in Des Moines:

Professor J. E. Todd,
Professor B. D. Halsted,
Professor F. M. Witter,
Professor H. W. Parker,
Professor R. E. Call,
Professor L. W. Andrews,
Professor Herbert Osborn.

The organization was determined upon as being the only practical method by which the working scientists of the State could be brought into close association.

At this first meeting the usual business of organization was supplemented by the presentation of a few scientific papers which are, so far as those reading them have responded to the request of the Secretary to furnish abstracts, presented herewith. The chief business of the session was rather more for purposes of permanently establishing the society on a useful basis than for the presentation of discoveries made in the course of original investigation. The Academy wishes to be understood as fostering only original investigations, and only such as are capable of work of this sort are knowingly admitted to Fellowship.

PROCEEDINGS

OF THE

Iowa Academy of Sciences,

FOR

1887, 1888. 1889.

Papers Presented at the First Session.

The following papers were read but no abstract was furnished by their authors for publication:

"On a New Astatic Galvanometer with a Spiral Needle," and one on the "Volumetric Determination of Lead, Barium and Sulphuric Acid," both papers being by Dr. L. W. Andrews, of the Iowa State University.

"Artificial Propagation of the Pollen of Certain Grapes," by Professor B. D. Halsted, of the Iowa Agricultural College at Ames.

The following abstracts were prepared by the respective authors who are severally to be held responsible for the opinions expressed:

ANIMAL INTELLIGENCE.

BY PROFESSOR H. W. PARKER.

(Abstract.)

So far as evolution is concerned, it really matters little at what point intelligence appears.

Intelligence proper includes the reasoning power as its chief and distinguishing characteristic. Facts regarded as proving a degree of this power in animals were reviewed in detail, and shown to be susceptible of a lower interpreta-

tion in harmony with the general phenomena of animal life. Some observations by the speaker were mentioned as illustrating the great principal that underlies the quasi-intelligence of brutes — marvellous keenness of senses along with no less wonderful quickness and retentiveness of association.

This, without the disturbing influence of reason, renders Darwin's theory of the building up of instincts a possible and credible solution. Spencer is right in classing these with reflex actions and referring, for example, the pursuit and capture of prey to the direct action of visual sensation or motor impulses. No line can be drawn except that we usually confine the word reflex to involuntary acts that immediately concern the integrity of the organism. Perception may or may not be present in either case.

The analogy between human and brute acts, which is sometimes so striking outwardly, is not valid psychologically,

1. Because instinct is unquestionably the ruling fact in animals. Besides there may be many latent or occasional instincts, or these may be simply modified by the force of circumstances in the outworking.

2. The exceptionality of the quasi-intelligent acts break in upon the analogy; and it is met by another analogy in the purely accidental character of some of man's seemingly wise deeds.

3. The superhuman senses and sense-associations of animals weaken the analogy, while accounting for much quasi-intelligence.

4. With such extraordinary senses, the frequent and gross blunders of brutes in perception should not occur on the theory of reason.

5. Animals low in the scale, including three sub-kingdoms, are not claimed to be intelligent; yet their acts, as given on good authority, offer as striking instances of seeming wisdom as in many of the higher divisions.

6. The quasi-reasoning of brutes is confined to specific lines of subsistence and defense, just where we may suppose their organism is endowed with all the activities needed.

7. It does not observably progress in the individual for life or in the species for ages. Such instances as new places of nest-building and increased wariness, are not of progressive mind; and this is not sustained by the facts used in favor of improvement or instinct by intelligence.

8. Rational mind, as we know it, begins in helpless ignorance and slowly comes to its powers by long trial and training.

9. The theory of rationality in brutes involves too high processes of thought in the simplest examples given.

10. There is no evidence in animals of a language of concepts — the necessity and accompaniment of reason in man.

11. The entire psychology of man is inseparable from his self-consciousness; and of such consciousness, which is the only kind we can really conceive, there is no evidence in brutes.

12. The analogy fails in the physical basis. The brain of even the highest ape is no better than a microcephalous idiot, in its volume. Below vertebrates, nothing has yet been proven to be homologous with the cerebrum, not even in ants. The best authorities show that the invertebrate brain, so-called, is shaped by the senses. It is a sensori-motor apparatus.

ANIMAL ÆSTHETICS.

BY PROF. H. W. PARKER.

(Read by Title.)

This is a review of all the material facts bearing on the appreciation of beauty by animals below man. The conclusion was that no such appreciation has been proven, and that it is excluded by the only theory of beauty that satisfies all demands.

THE TERRACES OF THE MISSOURI.

BY PROF. J. E. TODD.

(*Abstract.*)

This paper presented the results of observations made by the author, under the direction of the United States Geological Survey. It treated especially of the portion of the river between the Great Bend and the mouth of the Platte.

Three groups of terraces were recognized, viz: the Silt terraces, the Lower Bouldery terraces and the Higher Bouldery terraces.

The first are less than twenty-five feet above low water, below the mouth of the Niobrara, and rise gradually northward to the height of about one hundred and thirty feet near the mouth of Crow Creek. The second also rise northward from about seventy feet at the mouth of the Platte, to three hundred feet above the Great Bend. The third, which corresponds to the upper limit of the drift, below the mouth of the Niobrara, at an altitude of four hundred and twenty-five to four hundred and fifty feet, is traceable at about the same elevation, nearly to the mouth of the White. Irregularities in the elevation and number of these terraces were referred to the influence of tributaries, and to frequent changes while the trough was being deepened.

All of them, especially the higher ones, are largely composed of Cretaceous rocks. Above these, in the Bouldery terraces, there is generally a thick stratum of reddish till sometimes slightly banded or stratified. This is covered with a stratum of gravel and boulders, and above this is a thick layer of yellow silt. The Lœss of Eastern Nebraska seems to be the continuation of the silt layer of the upper Bouldery terrace.

The Silt terraces were referred to recent time; the Lower Bouldery, to the occupation of the Second Moraine by an ice-sheet; the Upper Bouldery terraces to a similar occupation of the First Moraine.

The trough of the Missouri has been formed since the advent of the Ice Age. Lake Cheyenne lingered till the waters from the great ice-sheet replenished it. Above Yankton the Missouri owes its present course, and possibly its existence, to the influence and interference of the ice-sheet. The distribution of pre-glacial lacustrine deposits, and the drift and loess, the character and height of the terraces the continued corrasion of the bottom of the trough to the present time, all sustain these conclusions.

THE ORIGIN OF THE EXTRA-MORAINIC TILL.

BY PROF. J. E. TODD.

(*Abstract.*)

This paper treated particularly of the morainic till of the Missouri Valley. To explain the origin of this till, there are two theories acceptable; one that it is sub-glacial, the other, that it was formed at the bottom of a glacial lake, gradually filling with debris brought from a glacier and the shore, by ice-rafts.

The sub-glacial theory is favored by (1) its close resemblance to till unquestionably sub-glacial. (2) striae on the underlying rocks. (3) the presence of osar-like ridges. (4) its difference from the reddish bouldery clay, often found above it, which is certainly of sub-aqueous origin, and (5) the thickening, and greater elevation of this till, near its outer margin, as along the east side of the Big Blue in Nebraska, suggesting an imperfect moraine.

Against these points, respectively, it was urged: (1) Close examination, not infrequently, reveals traces of stratification, by differences of color, and in the distribution of pebbles and boulders. (2) Striæ are the exception, even on similarly prominent surfaces. They, in some cases, show on the same surface directions diverging 60 degrees, and

with equal freshness. Their direction sometimes does not harmonize with their glacial origin. (3) The osar-like ridges are sometimes found on the outer slope of the outer moraine, and so related to channels across it as to indicate their contemporaneous or subsequent formation, and therefore cannot furnish evidence for an ice-sheet, which must have long antedated the moraine. (4) Notwithstanding the differences between the till and red clay, the former has been found to sometimes to pass gradually into the latter, and thick strata of the latter often present the same features and structure as the former. Therefore the relation of these formations to each other seems to favor sub-aqueous deposition of the former, rather than otherwise. (5) The thickened and elevated till does not exhibit the knob-and-basin structure common in moraines, and may be rationally referred to debris accumulated by bergs stranding on a shelving shore.

After replying thus to the arguments for the first theory, the following points were urged in favor of the second, or glacio-natant hypothesis:

1. Moraines and traces of ancient drainage channels found attending areas, which have been certainly glaciated, are not found attending the drift under consideration.
2. The rare and slight disturbance of underlying formations forbids the idea that the region has been occupied by an ice-sheet.
3. The slight proportion of local material, in the extra-morainic drift, indicates the same.
4. The evident former horizontality of the western margin of the drift, and the absence of drift at a higher elevation anywhere outside of the principal moraine.
5. The difficulty of conceiving an extension of an ice-sheet over the extra-morainic till, without violating well recognized conditions of glacial motion.
6. The filling of Lakes Agassiz, Minnesota and Dakota, with till to a considerable extent, argues strongly by analogy that Lake Missouri may have been similarly filled.
7. The correspondence of the upper limit of the drift in Nebraska to the upper bouldery terrace of the Missouri above

the mouth of the Niobrara, indicates that the drift mentioned was deposited under water.

8. The relation of the till to certain deposits of volcanic ashes which in some cases are below the drift, and in other localities are in it and above the till, suggests a possible demonstration of the sub-aqueous origin of the till under consideration. This ash deposit was made in still water. If there was but one deposition of volcanic ashes (and there is no proof yet known that such was not the fact), the evidence would be complete.

DIRECTIVE COLORATION IN ANIMALS.

BY PROF. J. E. TODD.

(*Abstract.*)

The paper was the outgrowth of observations made on the Western plains. It is published in full in the *American Naturalist* for 1888.

While recognizing the validity of protective, ornamental and typical coloration, as defined by Darwin, Wallace, Belt and others, the writer claimed that a very considerable amount of coloration in animals remained unexplained. For such as are of service somewhat after the manner of distinctive badges and uniforms to troops, or as signal flags and lights to boats and cars, he proposed the name *directive* coloration.

The following synopsis presents the principal features and applications of the principle.

Directive coloration is that which is in any way useful to a species by assisting in mutual recognition between individuals, or by indicating one to another their attitude and probable movements. To this head are referred:

1. Marks and tints promoting recognition at a distance, to guide in straggling flights, or to bring stragglers together, [A].
2. Those indicating the attitude of body, and its probable movement. [B] in darkness; [C] in close movements of

large numbers, in light as well as in darkness; [D] in sexual intercourse; [E] in the care of young.

A. [*a*] By general color contrasted with the environment; crows, blue birds, etc.

[*b*] By striking colors, which may be hidden when at rest, but automatically shown either during flight, at the moment of stopping, or during a calling cry, viz:

* About the tail, most mammals and birds which are protectively colored.

** About lateral appendages; ears in mammals, wings, in birds.

B. [*a*] By striking marks about the head and neck: raccoon, badger, etc., finches, etc., etc.

[*b*] By various spots and lines, on shoulders and sides; skunks, etc.

[*c*] By paleness of belly and inner sides of legs.

C. [*a*] Not only by marks already mentioned, but especially by vivid and extensive markings on shoulders, sides or flanks; zebra, etc.

[*b*] By special marks on feet and legs.

D. [*a*] By many of the lateral and caudal markings already mentioned.

[*b*] By different colors according to sex; night-hawks, etc., etc.

[*c*] By difference in extent or shape of markings according to sex; antelope, etc.

E. By various spots or lines appearing only in the young stages; deer, some *Suidæ*, and some *Felidæ*.

SOME FERNS OF THE OZARK REGION OF MISSOURI.

BY PROFESSOR R ELLSWORTH CALL.

(*Abstract.*)

This paper lists with certain remarks on habitat and geographical distribution, the species of *Filices* incidentally collected during a two months exploration of Shannon, Reynolds and Texas counties, Missouri. The species collected and represented by specimens exhibited with the paper are the following: *Pteris aquilina* Linn. abundant; *Phegopteris*

hexagonoptera Fee, rare; *Aspidium achrostichoides* Swz., among the specimens exhibited are many with bifurcated rachis or bifurcated pinnæ or pinnules; *Camptosorus rhizophyllus* Link, abundant on limestone cliffs; *Asplenium trichomanes* Linn.; common *Asplenium ebeneum* Aiton, somewhat rare; *Asplenium ruta muraria* Linn., rare; *Asplenium bradleyi* Eaton, occurred but once and then in some abundance on lime-stone rocks in Texas county; *Asplenium parvulum* rare; *Pellæa atropurpurea* Link, abundant; *Polypodium vulgare* Linn., not very abundant; *Polypodium incanum* Swz., very abundant in numerous localities; *Onoclea sensibilis* Linn., occurred but once in Shannon county, in a marsh-like area high up in the mountains; *Cheilanthes lanuginosa* Nutt., very abundant on limestone cliffs in dry situations and very large, occasionally; in some localities the rocks were entirely carpeted with this form; *Adiantum pedatum* Linn., occurred only in very damp situations and then was not common; *Adiantum capillus-veneris* Linn., occurred only once to us and then on limestone cliffs overhanging the Currant river, close to the water; *Woodsia obtusa* Torrey, abundant at one locality in Dent county, close to Shannon county; *Botrychium virgianum* Swz., rare; *Osmunda regalis* Linn., occurred once in a marshy area high up in the mountains; *Cystopteris fragilis* Bernh., abundant; *Cystopteris bulbifera* Bernh., abundant. The collection includes in all fourteen genera and twenty-one species. It is presented not as an illustration of the full fern flora, but as a contribution to a better knowledge of a little known area.

NOTES ON THE GROSS ANATOMY OF CAMPELOMA.

BY PROF. R. ELLSWORTH CALL.

(*Abstract.*)

This paper gave the results of certain studies made on abundant specimens of *Campeloma subsolidum*, completing certain details in the anatomy of the genus. Observations were made to determine whether there were any facts in the external anatomy that could be utilized in the determination of sex. This question was answered in the affirmative. The gross anatomy of the reproductive organs was then discussed and illustrations of the various parts were exhibited. Notes on fecundity were also submitted. The entire paper was published in the *American Naturalist*, Vol. XXII, pp. 491-497, in June, 1888.

ON A NEW FOSSIL LIMNÆID FROM THE POST-PLEIOCENE OF CALIFORNIA.

BY PROF. R. ELLSWORTH CALL.

(*Abstract*

This paper described as new to science, a fossil shell found in the post-pleiocene deposits of the Tassajara Hills, and now deposited in the collections of the University of California. It belongs to that sub-group of limnæid mollusks which is typified by the genus *Pompholyx*, but differs therefrom in some important particulars. It is made the type of a new genus and species, being described under the name of *Pompholopsis whitei*. The paper may be found in full in *The American Geologist*, for March, 1888, Vol. I, No. 3.

NOTES ON SOME SHELLS, FERNS, ETC.,

Collected in Decatur County, Iowa, and Lyon County, Kansas, in the Summer of 1886.

BY PROF. F. M. WITTER.

Abstract.

Grand River, Long Creek and the Little Rivers yielded almost no water mollusks.

Four examples of *Unio schoolcraftii* Lea, one *U. lævissimus* Lea, and one *Helix clausa* Say. Of the Ferns the following were observed: *Osmunda claytoniana*, *Botrychium virginicum*, *Adiantum pedatum*, *Cystopteris fragilis*, *Asplenium felix-fœmina* and *Onoclea sensibilis*.

In Kansas, at Topeka, an abundance of *Physa* and *Planorbis* were seen along the river in a pond.

At Emporia in the Neosha, in an hour, the following were taken; 32 *Unio undulatus* Barnes, 21 *U. gibbosus* Barnes, 7 of which had white nacre, 11 *U. rubiginosus* Lea, 5 *U. schoolcraftii* Lea, 4 each of *occidens* Lea, *anodontoides* Lea, *lachrymosus* Lea, and *coccineus* Hild., 3 *purpuratus* Lam., 2 each of *subrostatus* Say, *tuberculatus* Barnes and *ligamentinus* Lam., 12 *Marg. complanata* Barnes. 1 *rugosa*, Barnes, and 1 *Ano. bealei*, Lea, in all, 108 specimens. In Allen Creek, near by, were found *Unio camptodon* Say, *subrostratus* Say, *Unio parvus* Barnes, *undulatus* Barnes, *Marg. complanata* Bar., *Ano. bealei* Lea, *Planorbis trivolvis* Say, *bicarinatus* Say, *Physa anatina* Lea, *Ancylus tardus* Say, *Sph. stamineum*, Con, *transversum* Say, *Succinea ovalis* Gould, and the curious little mimic insect *Helicopsyche arenifera*.

Unio camptodon (12 specimens) were found to be alive after remaining out of water, in a very dry place, from July 22d till August 29th, 1886. They were kept alive at Muscatine in a tub of water till about the 1st of January, 1887.

PROCEEDINGS

OF THE

Iowa Academy of Sciences,

FOR

1888.

The annual session for 1888 convened in the Hall of the Young Men's Christian Association, Des Moines, Iowa, on September 5th, with a full attendance of the recognized membership present. After the formal induction into the office of president of the president-elect, Prof. Herbert Osborn, of the Iowa Agricultural College, the Academy listened to the following annual address:

LOCAL PROBLEMS IN SCIENCE.

BY PRESIDENT HERBERT OSBORN.

It may be said, with truth, that science knows no boundaries of geography, politics, sect or race. That if there is to her credit, any characteristic of permanence, it is that of universality. But admitting this cosmopolitan, universal characteristic, we may agree that in every country, State and community, there are scientific questions of special local importance and interest, questions which, while entering into the science of the world, having their relationship of dependence upon, and of support to, allied questions the world over, are still so local in their nature that only local interest is the warrant for their special investigation.

I deem it unnecessary therefore to offer any apology for asking your attention to a brief outline of certain scientific problems whose solution has special relation to the State of Iowa.

My paper naturally assumes the form of a brief review of the scientific work in the State, the progress that has been made in certain lines and the hasty mention of such as force themselves on your attention for the future.

The prosecution of scientific investigation in the State has not, as a rule, been assisted by organized societies or institutions to the extent seen in sister States, but such as have existed should, perhaps, receive first mention.

The first of such organizations to operate in the State was a government exploring party and scientific work apparently began when Thomas Say, as a member of Long's expedition to the Northwest Territory in 1819–20, collected and subsequently described many forms of life occurring in the State. His descriptions are to be found in the reports of the expedition and in the publications of the Philadelphia Academy.

The geological survey of Wisconsin, Iowa and Minnesota in 1848–52 appears to have been the first careful investigation into the geological formations of the State, followed, shortly after, in 1855–9, by the first State geological survey under Professor James Hall.

The second State geological survey was organized in the spring of 1866 and placed in charge of Dr. C. A. White. This survey was continued till 1869 and reports printed in 1870.

The Davenport Academy of Natural Sciences was organized in 1867 and has since 1876 published proceedings which contain many valuable papers upon the geology, natural history, etc, of the State of Iowa, more especially the portion adjacent to Davenport.

The Iowa Academy of Sciences, the only State Society, previous to our own, devoted strictly to the sciences and embracing especially the scientific problems of the State, was organ_ ized in 1875, and after having been the means of encouraging investigation in many portions of the State unfortunately died in 1884. Its brief published record of proceedings contains titles and abstracts of many valuable papers, many of which were published in full in various scientific journals.

Other scientific organizations have existed here and there over the State, but none publish regular proceedings and it is difficult to arrive at any opinion as to the extent or character of their work.

Mention should be made, however, of the Iowa Assembly of the Agassiz Association, which is one of the most prosperous in the country, and from which we look for devoted scientific workers in the immediate future.

In the transactions of the Iowa State Horticultural Society and the State Agricultural Society there may be found occasional papers upon the botany, ornithology, entomology and geology of the State. Most of these were prepared with special reference to their relations to horticulture and agriculture, but many contain contributions to the scientific literature of the State not elsewhere accessible.

In the biennial reports and the bulletins of the Iowa Agricultural College may be found papers on the meteorology and natural history of the State.

The State Weather Service, organized as a volunteer service by Dr. G. Hinrichs in 1875, has since 1878 received financial assistance from the State and the published reports of the service contain records of observation at many stations throughout the State.

These have been the principal channels of publication for essentially local scientific contributions and almost the only ones not dependent upon individual enterprise.

Students of anthropology have found in Iowa some extremely interesting fields for study, and the work in this branch which has centered mainly in the Davenport Academy has resulted in bringing to light many valuable facts. Some of the discoveries there made have been of so great importance in affecting the views of leading anthropologists as to have been the source of severe contention. There still exists an opportunity in the Indian tribes on the reservation in Tama County to study some of the details of Indian life, but I am not aware that the opportunity has been improved by any Iowa anthropologist. Possibly these Indians have mingled too much with civilization around them to furnish much of value concerning their former mode of life, and it may be that the tribes are already too well known to need further study.

The great advance made of late years in all studies pertaining to the past inhabitants of this continent render the further investigation of prehistoric remains in this State not only more interesting and significant, but must render the prosecution of such work and the interpretation of results more easy, certain and reliable.

The desire to know all we can of the past inhabitants of the soil we occupy has in it more than idle curiosity. The fact that nations were born, developed to their fullest powers, grew old and died, and were replaced by others to follow the same cycle on this the soil where we have established in their place a higher civilization, should lead us to look well to all weak points in our social and political structure. The history of the Aborigines of America may have its place in our education as well as the histories of the dynasties of the Old World.

In the line of zoology, while there has never been official support or workers numerous, such progress has been made as may furnish ready foundation for the work of coming students. As elsewhere, and from the nature of the case, more is known of the local *fauna* in our State among the vertebrates than in the lower groups of animals. The mammals are much the same as those of the adjoining States, but occupying the border land between the valley and the plain their distribution presents many interesting questions. The species now extinct or doomed to extinction by the invading presence of man have need of an historian, and his work can not be begun too soon.

The first attention given to the birds of the State was probably about the year 1820, by Thomas Say, though to what extent his collections were made strictly within our borders it is difficult to determine. Doubtless the famous Audubon in his many travels through the Mississippi Valley touched more than once upon our soil, and collected here some of the material for his famous drawings and descriptions. I do not recall, however, his statement of any localities now recognizable as within the State.

In 1868 Prof. J. A. Allen[1] published notes on Iowa birds, giving a list of many species occurring in the State. To this list Prof. H. W. Parker, of Iowa College at Grinnell, made a considerable addition in a note in the American Naturalist,[2] entitled, "Iowa Birds"; and in the report of the State geological survey under Dr. White, Prof. Allen presents a much more complete catalogue. Recently, Dr. H. S. Williams and Mr. C. R. Keyes have conjointly made an exhaustive study of the State bird *fauna*, and it is probable that but few species remain to be added to their catalogue.

Prof. F. E. L. Beal, Charles Aldrich, Prof. H. W. Parker, Mr. F. M. Tripp and others have contributed to our knowledge of local bird *faunæ* within the State, breeding habits, migration, etc.

While little may be left to do upon the *avian fauna* of the State at large, much may be done concerning local distribution as to valley, hill, forest or prairie, breeding grounds and time of appearance and disappearance of migatory spe-

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1—Mem. Bost. Soc. Nat. Hist. Vol. I. p. IV.
2—American Naturalist, Vol. V., p. 168.

cies. Especially is there the question so absorbing both economically and scientifically, as to their food, habits and the precise relation of each species to other branches of the organic world, all of which vary more or less with locality, and hence demand study in all parts of the State. The new division of ornithology and mammalogy in the United States Department of Agriculture furnishes opportunity for any disposed to assist in these problems to render contributions which may have far more than local value. Isolated observations, published in connection with many others on the same subject from different localities, become of far greater significance and value.

I am not aware of any record of the reptiles, batrachians or fishes, which pretends to represent the *fauna* of the State in these classes, and in the latter classes especially there is opportunity for rich returning to the investigator. A beginning has been made by Profs. Jordan and Meek who, a few years since, collected in some of the streams of Southern Iowa and published a list of species collected in Iowa, in the Proceedings of the National Museum. The economic aspects of the fishes are probably not fully appreciated by the people of the State, but are recognized to the extent of an official fish commissioner. A better knowledge of the breeding habits and food supply and enemies of the food fishes common to our streams and lakes would doubtless be of great advantage in assisting their multiplication, and alongside of attempts to introduce food fishes from abroad (and it seems to me more important than them) there should be an intelligent effort to further theproduction of the best species native to the State.

Of the invertebrates, no group can equal the insects, both in scientific and economic importance. Contributions in this branch have been made by Hoffmeister, Parker, Bessey, Putnam, Witter, Walton and the writer, with others whose names not now in mind may deserve equal mention.

Much of the work done has very naturally been upon the life histories of species, and frequently with reference to the vast economic relations they assume. While there is much of complexity in their study, and the beginner soon becomes appalled at the multiplicity of forms observed in his own locality, there is much to whet his interest and repay his efforts in study. Collections are easily made, and with a little attention to important details for their preservation might form useful and permanent adjuncts to education in every school district.

No faunal list in this group approximating completeness has been published, and for the present is out of the question.

Prof. C. E. Bessey published a preliminary list of the *Orthoptera* of Iowa in 1877.[3] Mr. J. Duncan Putnam published lists of the *Lepidoptera* and *Coleoptera* for Davenport, and also lists of *Coleoptera* collected atMonticello and Frederick.[4] Miss Alice Walton has given a lists of *Lepidoptera* for Muscatine[4] including mostly *Macro-lepidoptera*.[5] The writer has presented lists of *Rhopalocera Sphingidæ* and *Odonata* for the central part of the State to the Iowa Academy of Sciences, and at the last meeting of this association a preliminary list of the *Hemiptera* of the State. Also in connection with Mr. H. F. Wickham, of Iowa City, the fragment of a catalogue of the *Coleoptera* of the State.

Entomologically we occupy interesting territory, since in our fauna we have a mingling not of eastern with western forms, but of southern and northern. Many southern species find their northern limit within the borders of the State, and similarly northern species reach their southern boundary here. Moreover, we have frequent evidence of the partial innovation of southern forms—species which, apparently, reaching us as stragglers are able some seasons to fix them-

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3—Seventh Biennial Report of the Iowa Agricultural College, 1877, p. 205-10.
4—Proc. Dav. Acad. Nat. Sci., Vol I, 1875, p. 169-177.
5—Proc. Dav. Acad. Nat. Sci., Vol. II, p. 141-2.

selves and for a few generations, at least, to live and multiply.

Aside from the questions of native species and of the distribution in the State, there is work for any number of investigators upon the life-histories and habits of our native insects. There are hundreds, nay, I doubt not, thousands of insects, native to the State, concerning whose life history we know the merest fragment or nothing whatsoever. Of those which have been studied the ones best known seem to present the greatest number of problems open for further study.

In the *Crustacea* we have a wealth of material which no Iowan has as yet seen fit to mine. While doubtless our *fauna* agrees closely with that of Illinois or Minnesota, where this group has been studied more thoroughly, it would be both interesting and useful for some student to give the group his attention so far as to determine to what extent they are identical.

The *mollusks* of the State are receiving the attention of our worthy secretary, Prof. R. E. Call, and have been studied also by Profs. Pratt, Witter, Pilsbry, Shimek and others. We have as yet no complete faunal list, though the list by Prof. Pratt[6] and Prof. Call[7] given for certain localities cover pretty well the fauna of the State in the groups treated.

The economic relations they bear to aquatic life and to higher animals as the intermediate hosts for numerous parasites renders them important objects to study.

Of worms we know comparatively little. A few parasitic species and the universal earth worm (which means several genera and species) have been studied, but much remains to be done. Darwin (in his admirable memoir on the Earth-worm) has shown us plainly the great importance of this apparently insignificant animal, and other forms await

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6—Proc. Dav. Acad. Nat. Sci., Vol. I . p. 165-67.
7—Bull. Des Moines Sci., Vol. I., No. 1. p. 5 67.

future Darwins to show their relations to the economy of nature.

Our streams, ponds, ditches and swamps, like those of other States, swarm with the minute forms of life whose size renders them unnoticed, but whose existence is as full of incident as that of higher forms. I know of no attempt as yet to even enumerate the common forms found in the State. They are everywhere abundant, and to every possessor of a fairly good microscope offer a most delightful field of research.

Of such aquatic forms the *Crustacea* have already been mentioned. Prof. F. E. L. Beal has contributed notes on the *Tardigrada*. Of *Hydroids* we have, so far as yet known, but one or two forms though it is probable that others may occur. Of sponges a few of the fresh water species have been determined by Mr. Edward Potts, of Philadelphia, from specimens sent from Ames and recorded in his Monograph of fresh water sponges.[8] Of the *Protozoa* there are innumerable forms but so far as known except the description of one species by Prof. C. C. Nutting,[9] of Iowa City, no attempt at a systematic study of them has been made.

The flora of Iowa is to be congratulated on the fact that it has received the attention of some of the most eminent botanists of the day. Parry, Bessey, Arthur, Halsted, Holway, McBride and many others have contributed to a knowledge of our native plants.

The first contribution which has come to my notice is an elaborate list of species by Dr. C. C. Parry, published in the Report of the Geological Survey of the Northwest. The list enumerates above eight hundred species, a large part of which are credited to Iowa.

Messrs. Haupt and Nagel have listed the flowering plants of Davenport.[10]

8—Proc. Phil. Acad. Nat. Sci., 1887, p. 157-279.
9—Amer. Nat. Vol. XXII., p. 13.
10—Proc. Dav. Acad. Nat. Sci., Vol. I., p. 153-164.

Of the higher forms—especially the flowering plants—the catalogues by Prof. J. C. Arthur in the proceedings of the Davenport Academy may be taken as fairly complete for the State, but in the lower groups—to judge by the number of recent additions—the list is but begun, while their relations to agriculture call for careful study. Even for the better known part of the flora there is work for local collectors in determining the richness of their localities, in fixing the boundaries of species, or recording the progress of invading forms.

Among the lower forms, whose presence is of so much importance as sources of disease to both animals and plants, we have our full quota, and, while many of these are of equal importance elsewhere, there is every reason to push their investigation on Iowa soil. The mildews, rusts and blights as well as the hosts of bacterial forms present us with an array of problems so vital to the well-being of the community that it is not strange we should find investigations in progress on all hands. It is to be hoped that the State of Iowa shall produce its full share of investigators and reap as rich rewards as other States in the harvest of discoveries that have but begun. In this branch of study we have the contributions by Prof. C. E. Bessey, also numerous papers by Dr. J. C. Arthur, Dr. B. D. Halsted, Prof. T. H. McBride, Dr. C. M. Hobby and others.

I have already mentioned briefly the existence of the various geological surveys of the State. The first organized under the general government as the Northwest survey, and embracing Wisconsin, Iowa and Minnesota. So far as Iowa was concerned it must be considered as but a partial reconnaissance, and scarcely more than touched upon the geological problems in the State which are of most vital interest to her people and the science. It went far enough, however, to locate in general the different geological areas of the State, limited to some extent the coal area and described in a general way the rich sources of agricultural wealth, sources which have since been so abundantly utilized. Its reports contain also valuable papers upon the paleontology and botany of the State, and many chemical analyses of rocks, soils, fossil bones, etc.

The first State survey, organized when only a narrow border of the eastern portion had been settled, naturally directed all its efforts to that portion of the State, and as a consequence many of the most interesting and important portions of the State, geologically, were not even visited. The investigation of the lead region of Dubuque by Prof. Whitney was, however, so exhaustive and accurate that Dr. White considered it unnessary in the following survey to give it any attention. In addition to this, the survey did a great deal to make known the fossils of the older strata in the State and lay a foundation for further geological work.

This survey was, however, brought to a sudden close, and in a way that has ever since left discredit upon the legislature that permitted it. The director was left without funds for the prosecution of his work when but partially finished, a portion of his salary unpaid, and the State even refused to reimburse him for money he had advanced to pay his assistants and prepare plates for his reports.

The second survey, under State support, endeavored to operate more particularly in the portions of the State not previously examined, but in order to give a correct outline of the geology of the State as a whole and fill gaps in the previous survey, had necessarily to re-examine much of the ground already traversed. This second survey had scarcely completed a general reconnaissance of the State when it too was brought to a sudden termination; not, however, with so much of discredit in the manner of its termination.

In view of the circumstance of its preparation we must consider this report upon this survey as a most valuable contribution to the geology of the State. The formations were mapped with approximate accuracy, and in the location of the coal areas alone there has doubtless been a saving of vast sums of money to the State in prevention of useless prospecting for coal in portions of the State where coal could not possibly occur. Prof. W. J. McGee gives in the Tenth Census Report an excellent review of the quarries and quarry products of the State.

Of individual workers in geology we have had many of whom we may feel proud, and the contributions to this subject by Profs. Todd, Calvin, McGee, Call, Barris, Wachsmith and others* have added much to our knowledge.

Of especial interest and importance have been the studies of recent deposits, drift, lœss, etc., by Profs. McGee, Call and Todd, which, owing to the paramount importance of agriculture in our State, are of direct interest to the people of every portion of the State.

But how much remains to be studied in this direction? The recent discoveries and great advances in utilization of oil and gas render of absorbing interest all the geological formations where these may possibly occur. Their careful examination would be of great service to the people of the State, and might be the means of saving thousands of dollars by preventing useless prospecting.

The coal formations merit further investigation, and peat bogs, quarries, gypsum and other mineral deposits, with a host of minor subjects, in one part of the State or another, await scientific examination. The location of areas where artesian wells are liable to be secured would also be of great service, and even an approximate outline of such areas, possible from a knowledge of the character and slope of the geological strata in given localities might save large sums expended in boring for artesian wells in places where such wells cannot be expected.

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* Since the above was penned we have been pleased to note the appearance of several papers on Iowa geology, from Mr. Clement L. Webster and Mr. C. R. Keyes, in The American Geologist and American Naturalist.

Our State, with others in its latitude, has undergone the interesting phenomenon of glaciation, and every student of geology must have become absorbed in the problems presented, the exact outline of the moraines, the depth of the drift, the nature and origin of the detritus, the course of glacial and pre-glacial streams, and a host of other questions which repeat themselves in every neighborhood of the State, offer abundant opportunity for the local student of geology, and every contribution to the subject, no matter how local it may appear, helps to swell our knowledge of the ground on which we live.

Erratic boulders greet us on every hand, like sphinxes, each burdened with unanswered questions. Whence came they? How did they come, where and how were they formed? What their composition, their structure, their history? Surely, these questions cannot be answered alike for all we see. While some we may consider as for the present, at least, apparently settled, what we know must certainly be far less than that which is unknown. In elucidation of these the chemist, the physicist, and the geologist have all a part with test tube, crucible, microscope and a host of other appliances.

Closely intermingled with the geological problems of the State are certain lines of investigation in physics and chemistry.

The physical conditions connected with the formation of our soils and various geological deposits, while many of them universal in their nature, have all a local interest and many may be studied to excellent advantage at various parts in the State. The causes and conditions incident to glaciation, the phenomena of erosion and sedimentation which have so much to do with the present condition of our surface soils have all a physical explanation to be applied in individual localities.

Here, too, we may consider those physical conditions of the atmosphere whose changes have so much of vital concern for the organisms which exist upon the earth's surface.

The subject of meteorology has received a considerable amount of attention in the State. It will be, of course, impossible to mention all the parties who have contributed to this subject, either as individual observers or as reporters for some of the organized weather services. Records by Prof. Parvin were begun at Muscatine in 1859, and his record for 1850-6 is published in the First Geological Report. The United States Signal Service has had a number of stations in the State since its first organization, some of which have been volunteer and others supported by the service. The records have, for the most part, only appeared in the reports of the service, but for the station at Ames and conducted by Profs. Macomber and Hainer summaries of the more important observations have been published in the College Biennial reports.

The State Weather Service already mentioned, organized and directed by Dr. Gustavus Hinrichs, receives reports from some fifty volunteer observers scattered over the State, and the published records contain extensive tabulations of their reports.

Inasmuch as this service receives direct support from the State and the expense of publication is borne by the State, people naturally look for some return in the way of assistance in meeting the idiosyncracies of the "weather".

It is perhaps too much to expect that people in general will appreciate a mere record of the weather which is past, no matter what its scientific value or interest may be, nor will many appreciate the claim that long series of observations are still necessary as a basis for useful forecasts. The farmer gathering his crops, the merchant with perishable articles on hand, the man in any calling whose work or whose pursuit of pleasure is affected by the condition of the weather is far more interested in what the conditions will be in the twenty-four to forty-eight hours ahead of him than he can be in the weather of six months or a year in the past.

The occasional wail which is heard when the weather forecaster makes a mistake affecting any large area is in itself strong evidence that the predictions of the Signal Service are consulted daily by thousands of interested people, and that to a certain extent, at least, they base their plans for the day on such predictions. Such could not be the case if the service did not in the majority of cases prove useful by giving accurate predictions.

I believe that both science and the public welfare would be benefitted if there could be a proper connection between the State and Government services. The Signal Service spends annually large sums of money in supporting observers and distributing predictions by telegraph in our State. In so far as the State Service duplicates such work, there is loss of effort and money. The observations taken at different hours and under different instructions, are not readily compared for lack of uniformity.

I would not be understood as depreciating the work of our State Service or favoring any reduction of its resources but as suggesting merely the effort to so combine the work now carried on in entirely independent ways as to secure records capable of exact comparison, and distribute the greatest amount of valuable information to the people of the State.

In all of the various geological surveys a prominent place was given to chemical determinations of the different rocks belonging to various formations, and in a general way we have information upon this subject for the most important strata. The survey by Owens seems to have confined its work in this line to the Lake Superior region. In the survey under Prof. Hall much attention to the subject was given and the report by Prof. C. D. Whitney contains many analyses of rocks and minerals. In the second survey the report on chemistry, from Prof. Rush Emery shows a great amount of work upon the rocks, minerals, waters and coal of the State.

Aside from this, however, no little work has been done in the way of analyses of water from the various streams and other water supplies of the State, largely through the efforts of the State Board of Health. Messrs. Pope, Robbins, Shearer, Bennett, Andrews, H·rrick and others have done much in this line, and while in many cases these analyses have not been published in any form accessible to the scientific world, I believe that a careful collection and comparative statement of all that could be brought together would furnish an exceedingly valuable and interesting document.

Aside from the economic question of water supply for cities and towns, and omitting the question of mere organic contamination, such analyses must furnish a hint, at least, as to the mineral constituents of the soils from which the water is collected, and especially in the case of mineral springs or artesian wells some information as to the character of the deeper geological deposits, of their respective areas.

Chemical analyses upon rocks, coals, fossils, etc., throw light upon the conditions of their formation and though repeated for every locality in the State where a certain geological formation occurs each one would have its especial value in comparison with the others as determining difference in condition during formation at such various localities. Moreover the immense changes in chemical composition between contiguous strata of different formations and even in different strata of the same geological age indicate some striking change of physical conditions in the waters from which such rocks were precipitated, changes which we may never be able to discover but which must apparently be approached from the chemical standpoint and for which very complete series of determinations for related rocks must be essential.

The chemistry of plants and animals is a subject as yet but slightly worked, and one of growing importance. While it cannot be considered as local in its nature, the question as to how much of variation in composition is possible, and to what extent such variation is influenced by climatic and other physical conditions, is one which can only be determined by local investigations. Not only the organisms themselves but the product of organic activity and organic decay and dissolution are rich with unsolved problems.

The principal means at present existing for the illustration of the fauna, flora, geology and mineralogy of the State are connected with educational institutions. The State University, Agricultural College, Iowa College at Grinnell, Cornell College at Mt. Vernon, and possibly some others possess collections of some extent. In all of these, however, and necessarily from the educational standpoint, it will be found that much space is given to foreign animals, and that our local fauna is meagerly represented. In none of them is there anything like a comprehensive exhibit of the State fauna. The State University is rich in mammals from the Hornaday collection, and will doubtless have a good representation of the mammalian fauna of the State. The Agricultural College has a fairly complete series of the birds of the State, either mounted or in skins, also considerable collections of reptiles and insects.

The museum of the Davenport Academy has a more local object, and its museum is especially rich in anthropology. It will be seen that in no place in the State is there a collection especially devoted to exhibiting the resources of the State.

For the purpose of bringing such material together and making it available for purposes of knowledge, we have great need of a State collection which may be said to have for its special purpose the illustrations of the natural history of the

State. Until provided with such State cabinet or laboratory of natural history, Iowa will be behind her sister States in means for presenting to her citizens in concrete form a knowledge of her wealth in animal and vegetable life, in fossils, rocks, minerals, ores and soils, with all the other stores of geologic wealth, a knowledge of which has just begun. Such a cabinet and laboratory should have for its scope the illustration by properly mounted specimens of all the mammals that are resident in the State, or that have been known to occupy its territory in past time. The bison, the cayote, the deer, bear and panther thus brought out in the midst of our civilization would furnish us striking pictures of the rapid progress our State has seen, and these with the relics of their human contemporary, who occupied but did not possess, who inhabited but did not develop, who existed but did not *live*, whose history is but one of gluttony or starvation, warfare or animal enjoyment, all these so grouped as to teach their lesson of possibilities in human progress and attainment might well occupy an important position in the metropolis and political center of our wealthy State, a place where the thousands who annually travel in quest of pleasure or instruction, might be both entertained and instructed.

But not dwelling upon these forms which are past, such a collection would embrace, too, those living species that in one way or another force themselves on our attention. Some vitally affect the wealth of the State, and a collection illustrating their habits, open to the State at large, would be an object lesson that could but leave an impress on those who visited it.

The birds and mammals should be so arranged as to illustrate their habits and their relations to each and to other organisms and to the agriculture, horticulture, etc., of the State, the native insects in their multitudinous phases of existence, with other objects in like completeness. Such an enterprise may seem fanciful and visionary, but we need only to look to other States to see such work in progress. It would need time and perpetual aid from the State to keep it in progress when established, but compared with the importance of the matter to the State the outlay need be but insignificant. With it might be combined such scientific work in the State as a geological survey, and the investigation of the zoological, entomological and botanical problems of the State.

Many of the problems here mentioned are of such strictly local interest that we cannot expect scientific men or societies from without the State to engage upon them. Being connected with the sources of wealth in the State, of vital economic interest to the State at large, it would seem that no argument would be necessary to show the propriety of the State's assisting in their study. From the very nature of the case their full solution is impossible, and cannot be expected from private enterprise or even from community, town or county effort. The sources of wealth they affect are vital to the people of every section of the State, and as all would be benefitted all should bear part in support.

A geological survey of the State, for instance, can never be hoped for from private enterprise, though many scientific men have by their individual and unpaid efforts brought to light many facts of value to the State at large. Such a survey would not be confined in its direct assistance to the mining interests of the State, the study of regions likely to produce coal, oil and gas, or the quarries scattered here and there. Even if it was the benefit from fuller development of these resources must accrue to people throughout the State as well as to the immediate operators of such industries.

But the geology of the State of Iowa cannot but be occupied in large part with the more recent formations. The lœss and the drift, the alluvial deposits along our streams, in short, the formation and character of all our surface soils with their special aptitudes for agriculture. In these lie the great wealth of our State, richer than the silver sprinkled hills of the Rockies or the golden threaded quartz of California; more precious than the diamond strewed fields of Africa. The prairie soil of this fair State is rich in all that brings comfort and enjoyment to an honest, earnest people in quest of the means for self-improvement. Rich because it furnishes a never-failing mine of wealth. Its treasures are not exhausted with a single turning of the earth, but will remain a perpetual source of revenue to any people who will intelligently conserve and protect it.

It may be noted that I have not referred to the science of political economy, psychology, etc., but this is not because I underrate in any degree their importance in human progress and attainment. From their nature they are both local and universal, but it would prolong this address too much to give them any adequate consideration.

Problems of social life are being studied on every hand, and it may perhaps not be stating it too strongly to say that their results can be of great value only as they proceed upon the scientific method. The relations of individuals, communities, States and nations are not to be adjusted by the bombast of the politician or the mere oratory of the statesman. A scientific analysis of the conditions, complete as they may be, and accurate appreciation of cause and effect, are necessary in the study of these as well as biological or geological problems, and the best statesman is he whose talent and training enable him to follow the method of the scientist.

In the founding of this Society which meets now on the first anniversary, we have recognized the existence of problems in our State demanding scientific investigation. We have recognized, too, the well known principle of advantage in organized effort, the added stimulus and benefit accruing to associated work. We find the field broad and the work in waiting great. We find our numbers small and frequently broken into by removals of our members to more remunerative or attractive fields of labor. We find much that might discourage, but we may look with profit to what has been here accomplished under conditions possibly more discouraging than ours.

We should strive to make our work enduring, so that those who follow will not need to repeat what we have done. We should strive for that perfection of result that may challenge the inspection and criticism of the world of science. We should hold our science as above any comparison with the wages which may be paid for scientific work, scientific opinion or support to any theory as beyond the reach of contamination with money.

The laws of Nature do not change, and he who gives a wrong expression to them knowingly subverts the very foundation of scientific progress, for the progress of science is the progress of truth.

The following papers were also read and are here given in abstract:

ON THE METAMORPHOSIS OF A SPECIES OF ALEYRODES.

BY PRESIDENT HERBERT OSBORN.

(*Abstract.*)

A species of *Aleyrodes* occurring on *Festuca* was studied at time of emergence of *imagines* and presented the following points. The pupal scale is oval, slightly convex and marked above with four dusky spots. Within the scale may be seen, at the earliest stage noted, only a granular mass without distinction of head or other parts; later eyes become conspicuous, head distinct from body and the *prothoracic* and abdominal segments extend in flattened lobes to the margin of the scale, while the *mesothoracic* and *metathoracic* segments are contracted and thicker. The *imago* issues from a compound fissure on the dorsal surface, one limb of which is transverse and located over the thorax; the other arises from the median point of this fissure and extends anteriorly to the cephalic margin. Fresh *imagos* when subjected to slight pressure, as under the cover glass when mounted in balsam, have an extensive protrusion of the pleural fold on the *prothorax* and abdomen corresponding to the lobes of these parts in the *pupa*. The *imago* does not acquire its farinose character until some hours after emergence. The extension of the pleural fold on all but the wing bearing segments of the body suggests some interesting inferences on the origin of these organs (in *Aleyrodes*, at least), and it is hoped that more thorough study of the material in hand will furnish some basis for conclusions.

THE HEMIPTEROUS FAUNA OF IOWA.

BY PROF. HERBERT OSBORN.

(Abstract.)

No attempt at a catalogue of the insects of this order has yet been made, and though for several years attention has been given by the author to gathering material for such a catalogue, many of the families are as yet certainly very incomplete. The following groups are represented:

Heteroptera, twenty-one families, as follows: *Scutelleridæ*, two genera, two species; *Corimelænidæ*, one genus, three species; *Cydnidæ*, two genera, two species; *Pentatomidæ*, seventeen genera, twenty-six species; *Coreidæ*, eight genera, twelve species; *Berytidæ*, three genera, four species; *Lygæidæ*, seventeen genera, nineteen species; *Capsidæ*, twelve genera, fourteen species; *Acanthidæ*, two genera, two species; *Tingitidæ*, two genera, three species; *Aradidæ*, one

genus, four species; *Phymatidæ*, one genus, one species; *Nabidæ*, two genera, four species; *Reduviidæ*, seven genera, eight species; *Hydrobatidæ*, three genera, four species; *Veliidæ*, one genus, one species; *Saldidæ*, one genus, two species: *Belostomidæ*, two genera, two species; *Nepidæ*, two genera, two species; *Notonectidæ*, two genera, two species; *Corisidæ*, one genus, two species.

Homoptera, nine families: *Jassidæ*, ten genera, fourteen species; *Cercopidæ*, two genera, three species; *Fulgoridæ*, five genera, ten species; *Cicadidæ*, one genus, three species; *Membracidæ*, nine genera, thirteen species; *Psyllidæ*, one genus, two species; *Aphidæ*, fifteen genera, thirty-two species; *Aleyrodidæ*, one genus, two species; *Coccidæ*, seven genera, twelve species.

Parasita, one family: *Pediculidæ*, three [four?] genera, fourteen species.

CATALOGUE OF THE MAMMALS OF IOWA.

BY PROF. HERBERT OSBORN.

I have here brought together all the species known to exist or that recently existed in the State, and unless otherwise indicated assume the responsibility of a correct record. I have consulted Audubon, Coues and Allen, Jordan, and also a list by Dr. M. F. Goding, published in the Transactions of the Iowa State Agricultural Society (1882), page 329, and where the species is not known to me to occur in the State I have added in parentheses the name of the author who is taken as authority. I must add that a very few of the species included in Dr. Goding's list seem to me extremely doubtful.

CARNIVORA.

Felis concolor L. Panther. Doubtless once common.
Lynx canadensis Raf. Lynx. Rare at present.
Lynx rufus Raf. Wild cat. Becoming rare.
Canis lupus L. Wolf. In timber regions.

Chrysocyon latrans. Prairie wolf, coyote. Formerly very common.

Vulpes vulgaris Fl. Red fox. Not common.

Urocyon virginianus Erx. Gray fox. Western prairies (Aud.) (Goding)

Mustela martes L. Sable. Not common.

Mustela pennantii Erx. Fisher. Northern N. A. (Jordan), Iowa (Goding)

Putorius vulgaris Cuv. Least weasel; N. U. S. (Jordan). Iowa (Goding)

Putorius ermineus Cuv. Common weasel. Abundant.

Putorius lutreolus Cuv. Mink. Common.

Gulo luscus L. Wolverine. N. U. S. (Jordan), Iowa (Goding)

Taxidea americana Baird. American Badger. Becoming rare.

Mephitis mephitica Shaw. Skunk. Common.

Lutra canadensis Sabine. Otter. Rather rare.

Ursus arctos L. Bear. Once common, now confined to zoological gardens, traveling shows, etc.

Procyon lotor L. Raccoon. Common in wooded regions.

UNGULATA.

Bison americanus. Buffalo. evidently once abundant.

Cervus canadensis Erx. American Elk. Once common.

Cervus virginianus Bodd. Deer. Once common, now rare or gone.

CHIROPTERA.

Vespertilio subulatus Say. Little brown bat.

Vespertilio lucifugus LeC. Very similar to preceding.

Vesperugo noctivigans LeC. Silver black bat. Not rare.

Vesperugo serotina. Dusky bat. Two forms occur.

Atalapha crepuscularis LeC. Twilight bat. Not abundant.

Atalapha cinereus Beam. Hoary bat. Rather rare.

Atalapha noveboracensis Erx. Red bat. Our most abundant species.

INSECTIVORA.

Scalops aquaticus L. Mole. Probably common, but I am unable to say as to relative abundance of this and the following species.

Scalops argentatus Aud. and Bach. Prairie mole.

Condylura cristata L. Star-nosed mole. Not seen. U. S. chiefly northerly (Jordan), Iowa (Goding).

Sorex cooperi Bach. Western shrew. Fairly common.

Blarina brevicauda Say. Not seen. Iowa (Goding).

Blarina talpoides Say. Not seen. Iowa (Goding).

Blarina exilipes. One specimen in Iowa Agricultural College museum.

RODENTIA.

Sciuropterus volans L. Flying squirrel. Common.

Sciurus cinereus L. Fox squirrel. Abundant. Var. *ludovicianus*.

Sciurus carolinensis Aud. Gray squirrel. Abundant.

Tamias striatus L. Chipmunk. Common.

Spermophilus tridecemlineatus Mitch. Striped gopher. Very abundant.

Spermophilus franklini Sab. Gray gopher. Common.

Arctomys monax L. Woodchuck, ground hog. Common.

Castor fiber L. Beaver. Becoming rather rare.

Geomys bursarius Shaw. Pocket gopher. Abundant.

Zapus hudsonius Zimm. Jumping mouse. Fairly common.

Mus decumanus Pall. Brown or Norway rat. Common.

Mus rattus L. Black rat. Being supplanted by preceding (Jordan).

Mus musculus L. Mouse. Very abundant everywhere.

Neotoma floridana S. and C. Wood rat. One specimen at Iowa Agricultural College, probably taken at Ames.

Hesperomys leucopus Raf. Deer mouse. Not rare.

Hesperomys michiganensis Aud. and Bach. Michigan mouse (Goding).

Hesperomys aureolus Aud. and Bach. (Goding) Not seen, and I think doubtful.

Ochetodon humilis Aud. and Bach. (Coues and Allen)

Arvicola riparius Ord. Meadow mouse. Common.

Arvicola austerus LeC. Perhaps as common as preceding.

Synaptomys cooperi Baird. Coopers' mouse.

Fiber zibethicus L. Muskrat. Abundant.

Lepus sylvaticus. Common rabbit. Abundant everywhere.

Lepus campestris Bach. Prairie hare. One specimen at Ames.

Lepus callotis Wag. Jack rabbit (Goding). Very doubtful.

MARSUPIALIA.

Diadelphys virginiana Shaw. Opossum. Confined to wooded regions.

FRAGMENT OF A CATALOGUE OF THE COLEOPTERA OF IOWA.

BY PROFS. HERBERT OSBORN AND H. F. WICKHAM.

(*Abstract.*)

The collections in this extensive order of Insects, are now sufficiently full to give us, we believe, a fair idea of the *Coleopterous fauna* of the State. We desire however to make the list as complete as possible and present this fragment at this time mainly for the purpose of requesting that individuals having a collection of Iowa *Coleoptera* would send us either specimens or, if accurately determined, lists of the species they possess to be incorporated in the list. Some credit will of course be given for all such assistance and names of species returned if desired.

The list will have as its principal basis, first, the private collection of H. F. Wickham, second the collection of the Iowa Agricultural College, and third, the private collection of Herbert Osborn.

The fragment herewith presented embraces twenty one families containing two hundred and thirty-nine species.

As a number of the most extensive families are not included the enumeration will possibly exceed five times the number registered.

MY EXPERIENCE IN REARING VANESSA ANTIOPA.

BY PROF. F. M. WITTER.

(*No Abstract.*)

SOME ADDITIONAL OBSERVATIONS ON THE LŒSS IN AND ABOUT MUSCATINE.

BY. PROF. F. M. WITTER.

(*Abstract.*)

The unconsolidated material resting on the drift in and about Muscatine possesses many of the characters of the lœss and since it passes by insensible gradations into the latter it seems rather to belong to the lœss than to the drift.

The lower portion is generally most perfectly and beautifully stratified, the strata consisting of sand, clay, and occasionally some gravel, with small boulders of the granitic series, fragments of bituminous coal, etc. A very few calcareous concretions are found in the stratified basal beds and at one point good specimens of these concretions have imbedded pebbles. In the less evidently stratified portions abound several species of land shells and the eggs of one species are found. But little sand and this of the finest grain is found in the unstratified higher portions. In this have been found the teeth and largely the bones of two examples of *Rangifer caribou* and the greater portion of the antler of the same species most probably. Two or three species of fresh water mollusks have been found in what appears to be lœss.

THE PARVUS GROUP OF UNIONIDÆ.

BY PROF. R. ELLSWORTH CALL.

(*Abstract.*)

This paper gave a resume of the known facts in the geographical distribution of these small *Unios* and proposed the reduction of a number of forms to synonymy. The relation of the assumed specific differences to conditions clearly connected with environment was pointed out and a somewhat close relationship of forms hitherto supposed to be very distinct was evidenced by the specimens exhibited. The distribution of the various forms was adduced as an argument in support of identity particularly of those species which occur in Texas and in Georgia.

The type of the group is the very small form described by Barnes from the waters of Ohio. This form with considerable variations occurs throughout the eastern half of the Unites States as far as the State of New York. To the south it ranges westward to Texas and has there been subjected to such environmental conditions as to become very much prolonged posteriorly. The sexual variations here are so marked that the two forms, male and female, have been described under at least two specific names. In Georgia occur two or three forms which have been called species mainly on the differences of color of the *nacre*. Some of these at least are but modifications of the common *Unio parvus* of the North.

The group includes the following species described by Dr. Isaac Lea, of which list those in italics are believed to be synonyms. In the list the forms which it is proposed to recognize as species are given in the order of the date of their description, so that, if for any reason the reader should wish to determine the chronologic arrangement of the species it will be possible to do so.

Unio glans Lea.

(Read May 7, 1830.)

"Observations on the *Genus Unio*," Vol. I, p. 92, Pl. VIII, Fig. 12.

Unio paulus Lea.

(Read October 2, 1840.)

"Observations on the *Genus Unio*," Vol. III, p. 51, Pl. XV, Fig. 29.

Unio minor Lea.

(Read August 18, 1843.)

"Observations on the *Genus Unio*," Vol. IV, p. 276, Pl. XXXIX, Fig, 3.

Unio texasensis Lea.

(Read March 24, 1857.)

"Observations on the *Genus Unio*," Vol. VIII, p. 39, Pl. LXI, Fig. 184.

Unio bairdianus Lea.

(Read April 7, 1857.)

"Observations on the *Genus Unio*," Vol. VIII, p. 42, Pl. LXI, Fig. 186.

Unio granulatus Lea.

(Read March 5, 1860.)

"Observations on the *Genus Unio*," Vol. XI, p. 52, Pl. XVI, Fig. 46.

Unio germanus Lea.

(Read February 5, 1861.)

"Observations on the *Genus Unio*," Vol. XI, p. 53, Pl. XIX, Fig. 54.

Unio bealii Lea.

(Read June 3, 1862.)

"Observations on the *Genus Unio*, Vol. IX, p. 26, Pl. XXX, Fig. 273.

Unio marginis Lea.

(Read May 16, 1865.)

"Observations on the *Genus Unio*," Vol. XII, p. 15, Pl. XXXI, Fig. 69.

Unio cromwellii Lea.

(Read May 16, 1865.)

"Observations on the *Genus Unio*," Vol. XII, p. 18, Pl. XXXI, Fig. 54.

Unio cylindrellus Lea.

(Read June 2, 1868.)

"Observations on the *Genus Unio*, Vol. XII, p. 68, Pl. XLVIII, Fig. 121.

Unio corvinus Lea.

(Read June 2, 1868.)

"Observations on the *Genus Unio*, Vol. XII, p. 70, Pl. XLVIII, Fig. 123.

Unio corvunculus Lea.

(Read June 2, 1868.)

"Observations on the *Genus Unio*, Vol. XII, p. 74, Pl. L, Fig. 127.

Unio vesicularis Lea.

(Read September 15, 1873.)

"Observations on the *Genus Unio*," Vol. XIII, p. 41, Pl. XII, Fig. 34.

The synonymy of this group, therefore, will stand as in the subjoined lists and even here there is some doubt that the Texas forms should be held to be distinct.

Unio parvus Barnes.

- *U. pavlus* Lea.
- *U. minor* Lea.
- *U. marginis* Lea.
- *U. corvinus* Lea.
- *U. vesicularis* Lea.

Unio texasensis Lea.

- *U. bairdianus* Lea.
- *U. bealii* Lea.

Unio glans Lea.

- *U. pullus* Conrad.
- *U. granulatus* Lea.
- *U. germanus* Lea.
- *U. cromwellii* Lea.
- *U. cylindrellus* Lea.
- *U. corvunculus* Lea.

The type of the group is the form described by Dr. Barnes to which both in anatomy, habits and general characters all the shells herein named show most marked resemblances. If the Texas forms be excluded as synonyms, then they will fall under the division headed by *U. parvus*.

The main facts on which this species reduction is based are set forth in the subjoined tabular synopsis. The various species have been studied in such detail as large series of shells from all sections of the south and the west would enable. In some cases authors' types have been available.

SYNOPSIS OF THE SPECIFIC CHARACTERS OF THE PARVUS GROUP.

UNIO.	PARVUS.	CORVINUS.	MARGINIS.	PAULUS.	GLANS.	CYLINDRELLUS.	CROMWELLII.	GRANULATUS.
Outline	Elliptical, somewhat compressed.	Elliptical, inflated.	Elliptical, inflated.	Elliptical, inflated.	Ovate-elliptical, inflated.	Widely elliptical, somewhat cylindrical.	Elliptical, somewhat inflated.	Elliptical, somewhat inflated.
Substance of shell	Thin, slightly thicker before.	Somewhat thick, thicker before.	Somewhat thick, thicker before.	Thick, thinner behind.	Rather thick.	Thick, thicker before.	Rather thin, thicker before.	Rather thin, slightly thicker before.
Beaks	Slightly prominent, coarsely and concentrically wrinkled.	A little prominent.	Somewhat prominent.	Somewhat prominent.	Somewhat prominent.	Slightly prominent.	Somewhat prominent; concentrically folded.	A little prominent, undulate, granulate.
Ligament	Small, thin, light straw-colored.	Short, thin, very dark brown.	Small, thin, light brown.	Short, thin.	Small.	Rather long, thin.	Small, thin, rather light brown.	Small, thin, light brown.
Epidermis	Yellowish green, lighter on beaks, striated, lines of growth distant, black.	Black, eradiate, subsquamose, growth lines close.	Dark olive striate, obscurely rayed, margin greenish-yellow.	Nearly black.	Black or dark brown sometimes rayed.	Yellowish, eradiate; lines of growth distant.	Striate, brownish or greenish rayed, growth lines distant, broad.	Dark olive, eradiate, striate, lines of growth distant.
Cardinal teeth	Small, elevated, acuminate, crenulate, double in the left, single in the right valve.	Small, decussate.	Small, sulcate, crenulate.	Small, disposed to be double in both valves.	Rather large, elevated, double in left, single in right valve.	Small, sub-conical, corrugate.	Small, compressed, corrugate, double in both valves.	Small, compressed, crenulate, oblique, double in both valves.
Lateral teeth	Slightly curved, long, lamellar,	Long, somewhat straight.	Rather short, straight.	Long, curved.	Straight, lamelliform	Long, somewhat curved.	Rather long, somewhat curved.	Long, acicular, nearly straight.
Anterior cicatrices	Distinct, moderately impressed.	Distinct, small, well-impressed.	Confluent, small, deeply impressed.	Distinct.	Distinct.	Distinct, small, well impressed.	Scarcely distinct, large, well impres'd	Distinct, rather l'rge well impressed.
Posterior cicatrices	Confluent, slightly impressed.	Confluent, slightly impressed.	Confluent, small, slightly impressed.	Confluent.	Confluent.	Distinct, small, slightly impressed.	Confluent, rather l'rg slightly impressed.	Confluent, rather l'rg slightly impressed.
Dorsal cicatrices	Center of cavity of the beaks.	Center of cavity of the beaks.	Center of cavity of shell [beaks?]	On inferior part of tooth.	Center of cavity of the beaks.	Center of the cavity of the shell.	Center of cavity of the beaks.	Center of cavity of the beaks.
Cavity of shell	Shallow, white.	Deep, wide.	Rather shallow.	Deep.	* * * *	Deep, wide.	Deep, wide.	Deep, wide.
Cavity of beak	Shallow, rounded.	Shallow, obtusely angular.	Shallow, rounded.	Very small.	Wide, subangulated.	Rather deep sub-angular.	Small, obtusely angular.	Shallow, sub-angular.
Nacre	White, inclined to salmon in cavity of beaks.	White, iridescent.	White, iridescent.	White, iridescent.	Purple.	Purple, iridescent.	Purple, iridescent.	Purplish, iridescent.
Habitat	Ohio river.	Flint River, Ga. Neuse River, N. C.	Dougherty Co., Ga.	Chattahoochee River, Ga.	Ohio River.	E. Tennessee, N. Ga., N. Ala.	Kiokee Creek, Albany, Ga.	Big Prairie Creek, Ala.
Diameter	.6 inch.	.7 inch.	.5 inch.	.4 inch.	.7 inch.	.7 inch.	.4 inch.	.45 inch.
Length	8 inch.	.8 inch.	1.0 inch.	.6 inch.	.8 inch.	.8 inch.	.7 inch.	.62 inch.
Breadth	1.6 inch.	1.3 inch.	1.1 inch.	.9 inch.	1.3 inch.	1.5 inch.	1.1 inch.	1.10 inch.

SYNOPSIS OF THE SPECIFIC CHARACTERS OF THE PARVUS GROUP.

GERMANUS.	CORVUNCULUS.	PULLUS.	VESICULARIS.	TEXASENSIS.	BAIRDIANUS.	BEALII.	MINOR.
Elliptical, somewhat inflated.	Elliptical, somewhat inflated.	Elliptical, somewhat inflated.	Elliptical, inflated.	Elliptical, sub-compressed.	Elliptical, slightly inflated.	Elliptical, somewhat-compressed.	Eliptical. rather inflated.
Somewhat thick, thicker before.	A little thick, thicker before.	* * * * *	A little thick, thicker before.	Rather thin, thicker before.	Rather thin, thicker before.	Slightly thickened, thicker before.	Thick, thinner behind.
Rather prominent, concentrically undulate.	A little prominent, concentrically undulate.	Slightly prominent.	Slightly prominent.	Slightly prominent, subconcentrically undulate.	Slightly prominent, concentrically undulate.	A little prominent.	Rather prominent.
Short, thin, lightish brown.	Short, thin, brown.	* * * * *	Rather long and thin.	Small, thin, yellowish-brown.	Small, thin, yellowish-brown.	Short, thin, dark brown.	Short, thin.
Dark brown, eradiate, transversely striate.	Blackish, eradiate; lines of growth distant.	Dark, olivaceous, wrinkled.	Dark olive, obscurely rayed, growth marks distant.	Dark olive, shining, obsoletely rayed, marks of growth distant.	Dark brown, obsoletely radiate, growth lines distant.	Dark brown or blackish, obscurely radiate, marks of growth distant.	Striate, nearly black
Small, erect, compressed, crenulate, acuminate.	Small, erect, compressed, crenulate.	Oblique, single in one, double in the other valve.	Small, sulcate, somewhat compressed, double in both valves.	Small, erect, crenulate.	Small, erect, acuminate, crenulate, double in both valves.	Small, compressed, crenulate, pointed, double in both valves.	Rather large.
Thin, somewhat curved.	Rather long, slightly curved.	* * * * *	Rather long, lamellar, nearly straight.	Long, lamellar, somewhat curved.	Long, lamellar, somewhat curved.	Very long, slightly curved, lamellar.	Small, curved.
Distinct, small, well impressed.	Distinct, small, well impressed.	* * * * *	Distinct, small, well impressed.	Distinct, small, well impressed.	Distinct, small, somewhat impressed.	Distinct, rather large, moderately impressed.	Distinct.
Confluent, slightly impressed.	* * * * *	* * * * *	Confluent, rather large, moderately impressed.	Confluent, slightly impressed.	Confluent, slightly impressed.	Confluent, slightly impressed.	Confluent.
Center of cavity of beaks.	Center of cavity of the beaks.	* * * * *	Center of cavity of the beaks.	Across the cavity of the beaks.	Across the cavity of the beaks.	Across center of cavity of the beaks.	Center of cavity of the beaks.
Rather deep, wide.	Deep, wide.	Very capacious.	Deep, wide.	Somewhat deep, wide.	Small, wide.	Shallow, wide.	Deep.
Shallow, obtusely angular.	Shallow, obtusely angular.	Very capacious.	Shallow, obtusely angular.	Shallow, obtusely angular.	Shallow, obtusely angular.	Shallow, obtusely angular.	Rather deep, angular.
Purplish, iridescent.	Purple, iridescent.	Chocolate purple.	Whitish, iridescent.	Bluish, very iridescent.	White, very iridescent.	White or pale salmon, iridescent.	Pearly white, iridescent.
Coosa River, Ala.	Swamp Creek, Whitfield Co., Ga.	Wateree River, S. C., Warm Spa, N. C.	Lake Ocheechobee, Fla.	DeWitt Co., Texas.	Devil's River, Texas.	Leon Co. and Rutersville, Texas.	Lakes Monroe and George, Fla.
.55 inch.	.5 inch.	* * * * *	.5 inch.	.5 inch.	.4 inch.	.6 inch.	.4 inch.
.82 inch.	.7 inch.	* * * * *	.7 inch.	.8 inch.	.7 inch.	1. inch.	.6 inch.
1.40 inch.	1.2 inch.	* * * * *	1.3 inch.	1.4 inch.	1.2 inch.	1.7 inch.	.9 inch.

THE GEOLOGY OF CROWLEY'S RIDGE, ARKANSAS.

BY PROF. R. ELLSWORTH CALL.

(*Abstract.*)

Crowley's Ridge is a low range of hills forming the only conspicuous feature in the topography of Northeastern Arkansas, and extends in a general north and south direction from the Missouri state line to the city of Helena, where it ends abruptly. The total length is therefore about 145 miles. It is a range of hills of varying width, its average being about four to six miles. The elevation is, on the average, from 175 to 250 feet above the surrounding country. The general surface is very irregular and presents a fine example of quaquaversal erosion, the heads of the numerous ravines often departing from the same point.

The age of the ridge is a matter of some question for it is largely made up of deposits that are believed to be of the age of the Orange Sand deposits. That the age of these sands is yet in dispute results from the fact that their mode of origin is not well understood, and besides they differ so widely at many points of their distribution. It has, however, been assumed in these notes that they are properly to be classed with the quaternary, and that has been the constant reference made; whether this treatment is a proper one must be determined by additional work in the field.

In general, the ridge may be said to be composed of tertiary strata of Eocene age representing the Claiborne beds of Alabama. These beds contain many Clainbornian fossils, though the *Ostreidæ* occur in the greatest abundance. The localities in which these forms occur most numerously are few and widely scattered, but are of the same age and of the same value petrographically. The ridge is capped with deposits of lœss that are the same in all essential features as are the deposits in the regions farther north. These lœss beds lie directly upon the gravels of the Orange Sand, and are sometimes, though not always, separated therefrom by beds of sand apparently derived from the tertiary deposits of the circumjacent region. The characteristic lœss-kindchen are present, but different from those of the north in being solid and never hollow. The ridge represents a mass of quaternary and tertiary sands and clays that have escaped, thus far, the great erosion to which the whole region has been subjected since tertiary times. It represents, therefore, the plateau of tertiary beds which resulted from the retirement of the Gulf in the early quaternary. There is little of economic value in these deposits, although the shell marl of one or two localities promises to have some local value. No mineral deposits of any moment are to be found in the ridge, and its top is of little agricultural value because of the difficulty of tilling. The paper was to be considered as tentative only as an additional season of field work was needed to settle some facts connected with the genesis of certain sands thought to be tertiary in age. The final results will appear in the annual reports of the Arkansas Geologic Survey, under the auspices of which organization the work was done.

CYNIPIDS AND CYNIPIDOUS GALLS ON OAKS COMMON TO IOWA.

BY PROF. C. P. GILLETTE.

(*Abstract.*)

For full scientific descriptions of the species herein mentioned see the Report of the Michigan Agricultural Society for 1888.

Andricus foliaformis, n. sp. The galls of this species occur on the under side of the leaves of the white oak (*Q. alba*). They consist of small wart-like projections which spread out in a leafy expanse on all sides so as to remind one of the corolla of a rotate flower. Rare. The fly measures about six-tenths of an inch in length; color of head and thorax black, fading into brown; abdomen a shining brown, darkest above; scutellum with two pits at base; *antennæ*, 13-jointed. Male not known.

Biorhiza rubinus, n. sp. The galls appear in the fall on the leaves of the white oak (*Q. alba*), a little before the foliage begins to turn dark brown. They are sub-globular in form, and while growing are rosy in color (sometimes almost white), and are translucent and pulpy like a green grape. Large specimens measure one-eighth of an inch in diameter. After reaching their growth, the galls turn brown and become only a thin shell which is very smooth and glossy next to the leaf. The mature gall is somewhat flattened above and below. I have found this gall quite common both in Michigan and Iowa. The flies emerge late the following summer. The fly is about six-tenths of an inch in length, is shining black in color, and has on the joints of the legs a yellowish-brown. When highly magnified, the body appears to be covered with minute scales. The fly is sparsely haired; *antennæ*, 13-jointed; parapsidal grooves shallow and indistinct; scutellum with two shallow pits at the base. Males not known.

Holcaspis basettii, n. sp. The gall of this and ot the succeeding species I have taken on the swamp white oak (*Q. bicolor*) only, but have no doubt but what they also occur on the burr oak (*Q. macrocarpa*). The galls of *H. bassettii* are usually found in clusters of from two to thirty or more crowded together about small limbs. The galls, unless pressed out of shape in the cluster, are sub-globular in outline with a stout teat-like projection which seems to be a drawn out portion of the substance of the gall. Medium sized galls measure five-eights of an inch in diameter. The gall is composed of a corky substance, and has an egg-shaped central cell that is easily removed by cutting open the gall.

This gall differs from a very similar species, *H. duricoria*, Bass., which occurs on the same oaks, in that the latter has a very small, almost horny, teat-like projection, is more globular in form and has the central cell with its greatest diameter parallel with the limb. *H. bassettii* on the other hand, has the greatest diameter of the central cell perpendicular to the limb at the point of attachment of the gall. I am sure that one who has seen typical forms of both species will never mistake the one for the other. The flies appear in November, and are all females. Length, one-sixth of an inch; prevailing colors, black and brown; but on account of a dense gray pubescence which covers nearly all parts, they have a grayish appearance until denuded; *antennæ*, 13-jointed, third joint the longest. Thorax marked with what seems to be six longitudinal black lines which extend partially or entirely across it; abdomen shining black with a patch of gray pubescence beneath the wings on either side.

Cynips nigricens, n. sp. Irregular cone-shaped galls which occur in clusters on the under side of the leaves of the swamp oak (*Q. bicolor*). The galls are attached to the mid-rib and fall to the ground a little before the leaves begin to drop in October. These resemble very much small clusters of *Cynips strobilana* O. S. Fly, black in color; nearly one-eighth of an inch in length; body appearing to be covered with minute scales, when viewed with a high power; *antennæ*, 13-jointed and slightly clubbed; parapsidal grooves deep and narrow and widely separated at collar; abdomen minutely punctate and set with hairs. Only known in female form.

Acraspis villosus, n. sp. The galls are very hard globular excrescences on the under side of the leaves of the burr oak (*Q. macrocarpa*). The galls are light yellow in color and are covered with a dense growth of stout hair of the same color. Large specimens of this gall measure over one-fourth of an inch in diameter. The galls contain a single fly each, appear about mid-summer, and the flies begin to escape about the last of October. Fly, nearly one-sixth of an inch in length; prevailing colors, cinnamon brown and black. The sides of the abdomen have a beautiful velvety luster, caused by a dense yellowish-gray pubescence which suggests the name of the species. The wings are aborted, being only short stubs. Females only have been reared.

Neuroterous nigrum, n. sp. The galls of this species appear as small pimples on the leaves of the white oak (*Q. alba*), and the burr oak (*Q. macrocarpa*). They are from one-sixteenth to one-twelfth of an inch in diameter, and show equally well from either surface of the leaf. The galls appear in August and the flies emerge the following summer. Fly, very small, about one-twenty-fifth of an inch in length, and black in color, except the tarsi and joints of the legs, which are brown.

Amphibolips cookii, n. sp. Globular galls with central cells and stout radiating fibers. They occur in the fall of the year on the buds of the red oak (*Q. rubra*). The growing gall resembles very much the gall of *A. inanis*, O. S., but it is smaller, and the radiating fibers and the outer shell are much heavier. A little before the leaves fall these galls drop to the ground, turn brown in color, and soon become much shriveled up. The flies do not appear until late the following summer. Fly, only females were reared. Length, one-fifth of an inch; general color, black; *antennæ*, 13-jointed, with the third joint the longest: face deeply pitted or sculptured; thorax and scutellum deeply sculptured; legs, amber colored; wings somewhat smoky and with a large stigmal spot. Only females reared.

THE LINEAGE OF LAKE AGASSIZ.

BY PROF. J. E. TODD.

(*Abstract.*)

As Lake Winnipeg has succeeded Lake Agassiz, so the latter may trace its lineage back three ages, as follows:

First. When the ice sheet filled the basins of Lake Agassiz and blocked the valley connecting the Red River and James River valleys, Lake Dakota extended 140 miles long, ten to thirty miles broad from Oakes to Mitchell, Dak. A level plain 1300 feet above the sea now occupies its former basin.

Second. When the Ice Sheet occupied the second or Gray Moraine in the James Valley, filling the basin of Lake Dakota, there was a quite extensive White Lake, occupying the basin of a diminutive descendant of that name in Aurora County, Dak., its altitude about 1557 feet. Also, a smaller and more transient lake — James Lake — southwest of Mitchell, extending into Douglass County; the present altitude of its western border is about 1450 feet.

Third. Still earlier, when the ice occupied the first or Altamont Moraine, or as some leading glacialists would say far antecedent to that time, during the latter part of a first glacial epoch, a great body of water occupied all eastern Nebraska, western Iowa and adjacent parts of Minnesota and Dakota. Its most characteristic deposit is the lœss. This lake was named Lake Missouri about ten years ago (*vide* Proc. A. A. A. S. 1877, p. 291). The general level of the lœss slopes southward, two feet to the mile; and eastward three to five feet, west of the Missouri, and one to two feet east of it. Its altitude is 1800 feet in Wayne County, Neb., and 1000 feet at Marysville, Missouri.

Under the drift in the Missouri Valley are Lacustrine clays and sand, which, further west lie directly beneath the lœss, strongly suggesting the conclusion that Lake Missouri may have been the direct successor of the line of grand Tertiary lakes, so ably outlined by King (Expl. 40th Paral., vol. I, p. 458).

Fourth. Lake Cheyenne occupied the plains from Texas to Manitoba and eastward well toward the Mississippi during the Pliocene.

Fifth. Sioux Lake in the Miocene covered the western portion of the Great Plains.

Sixth. In the Eocene, the surface of the plains was dry, but probably not so further north. If not, then this Eocene lake or bay would fill the gap and connect this royal line of lakes with the ocean. Possibly Lake Missouri may have done so much later with the Gulf of Mexico.

ON THE FOLDING OF CARBONIFEROUS STRATA IN SOUTHWESTERN IOWA.

BY PROF. J. E. TODD.

(Abstract.)

Most who examined the rocks along the Missouri River in the region under consideration have been constrained to record some folding, but such statements have been rather indefinite and have hardly expressed sufficiently the abruptness of the folds.

Before noting the evidence of foldings it will be well for us to briefly notice the character of the strata folded. They consist of a mixture of limestone, clays, marlites, slates and sandstone. The change from one to another is usually abrupt and frequent. Meek concluded that the nature of a stratum changed so much horizontally that lithological characters were of little importance in determining equivalence in adjacent localities. This may be true compared with some regions, but the more frequent exposures of the present time make it quite possible to show that the strata have fair persistence, and may be traced scores of miles, by their lithological and stratigraphical characters alone.

A fairly complete section of the rocks of southwestern Iowa may be found by placing in order the section at Wyoming, the section at Nebraska City, with Croxton's boring, (*vide* Hayden's Final Report, Nebraska, pp. 101, 106), the sections at Wilson's, (White's Report on Iowa, Vol. 1, p. 358), the section at Rock Bluff, and the section below Plattsmouth, (Hayden's Report). Giving this in brief form, omitting the finer details we have the following:

SECTION OF UPPER CARBONIFEROUS ROCKS IN SOUTHWESTERN IOWA.

1. 18 to 19 ft. Blue, red and ash colored clays, with two distinct layers of limestone 2 feet and 4 feet in thickness respectively.

2. 10 ft. Yellowish, micaceous, soft sandstone.

3. 39 ft. Drab, ash, lead colored and chocolate colored clays, with only one thin layer of bluish limestone.

4. 12 ft. Limestone in thin layers, light yellow and gray.

5. 185 ft. Thin layers, mostly of gray shades, though red and blue occur, with five thin beds of limestone and four of sandstone. (This is derived only from Croxton's boring and is quite indefinite both as to its real character and as to its relation to observed sections).

6. 12 ft. Bluish limestone, inter-stratified with black shades and with nearly one foot of fair coal near its center.

7. 30 ft. Drab clays, enclosing three distinct shades of limestone, 2 to 4 feet thick.

8. 20 to 24 ft. Compact limestone, thin bedded and stylolitic more or less.

9. 6 to 12 ft. Drab clays carbonaceous in two horizons and containing two thin strata of limestone.

10. 12 to 25 ft. Soft, fine-grained, yellow sandstone.

11. 35 to 45 ft. Clays and slates, bluish and gray, containing 3 or 4 strata of limestone, one much the thickest, sometimes 7 feet thick.

12. 16 to 20 ft. Limestone yellow and gray (*Fusulina*).
13. 5 ft. Clays.
14. 4 ft. Yellowish incoherent sand.
15. 10 to 12 ft. Limestone.
16. 25ft. Greenish and chocolate clays above and shales below.
449 to 490 ft. Total thickness.

This is a rather surprising result, after we have been accustomed to referring only 200 feet to the upper carboniferous, as estimated by Dr. White. Some of this may be considered somewhat doubtful still, but at least 350 feet is demanded by facts, as we shall see. The most frequently exposed members of the series are the upper and lower beds of limestone, Nos. 8 and 13, which, from their relation to the clays and sand, are especially apt to form benches, cliffs and rock-houses. It is the upper of these which has furnished the most stone in quarries as at South Bend, Weeping Water, Bennett and Roca, in Nebraska, and Shaw's and Wilson's, in Iowa. The sandstone 12 to 15 feet below the limestone was considered by Dr. White to be the lowest stratum exposed in southwestern Iowa. Several years residence in the region, and numerous observations of many exposures which were not accessible to Meek and White, have led the writer to conclude:

First. That thirty to fifty feet of strata below the said sandstone are exposed in the vicinity of Pacific Junction, as also at Plattsmouth.

Second. That the sandstone which Dr. White discovered south of Fremont City is not the equivalent of the said sandstone in the lower part of Wilson's Quarry, as he inferred, (White's Geol. Vol. 1, *in loc.*), but is of a considerable higher geological horizon. This is shown by the following facts.

(1.) Although the two sandstone strata may be traced at nearly the same level within a half a mile of each other, yet their associated strata are entirely different. One is No. 2, the other No. 11. The former is the sandstone in the Nebraska City and Wyoming sections, the latter that in the Cedar Bluff and Rock Bluff sections, on the Nebraska side.

(2.) At Jones' Point, just above the junction of the Weeping Water with the Missouri, there is a fine expanse, which seems to have escaped Meek and Hayden. It shows a dip of four to five degrees to the south-southeast, which carries over 100 feet of strata, which are exposed as the summit of an anticlinal, shown about a mile north, entirely below the level of the river, in less than that distance.

(3.) The highest limestone in Croxton's boring at all comparable with stratum 8, is that of Nos. 34 and 35, (*vide* Hayden's Final Report, Nebraska, p. 106), 200 feet below the surface of the Missouri. As this stratum has been quite constant for twelve to fifteen miles east and west, it may fairly presumed to be so to this distance south, and making fair allowance for the obscurities of boring records we may consider the identification quite probable if not demonstrated.

(4.) Taking the bottom of stratum 8 as our plane of reference, we find a high anticlinal axis in the vicinity of Plattsmouth on the Missouri, and a little east of Weeping Water town, on the stream of that name, and a lower one more clearly exposed one and one-fourth miles above Jones' Point on the Nebraska side of the Missouri, and a little south of Wilson's on the Iowa side of the valley. The sharp fold immediately south of the latter which has been noted at Jones' Point may become a fault south of Wilson's.

The position of the bottom of stratum 8 is illustrated concisely in the following table:

	Omaha........	Bellevue........	La Platte........	Plattsmouth.....	Rock Valley....	Kenosha........	North of Jones' Point........	Jones' Point....	Wyoming........	Nebraska City..
Altitude of limestone above Missouri River.....	38.?	0.	35.?	140.	103.	50.	.90	-.50	-200.	-225.
Distance in miles south of Omaha..............	0.	5.	8.	14.	19.	22.	.26	.27	.30	35.

(5.) The trend of the fold at Jones' Point is north 50 degrees, east 60 degrees, approximately parallel with the northern border of the carboniferous, viz: a line passing through Dunlap, Iowa, and Rockport, Omaha and Ashland, Nebraska. Also with several exposures in Nebraska and Iowa which may be found to be along the higher anticlinal, viz: Roca, Bennett, Weeping Water, Glenwood, Malvern Macedonia, etc.

(6.) Paleontological evidence seems to coincide with the conclusions from stratigraphy. Of the more than one hundred species, listed by Meek as found in eastern Nebraska, twenty are found north the steep fold at Jones' Point and not south; forty-seven are found south which are not north, and thirty-five are found on both sides of the line.

PROCEEDINGS

OF THE

Iowa Academy of Sciences,

FOR

1889.

The third annual session of the Academy was held in the city of Des Moines on September 5th, 1889, in the Science Rooms of the High School building. There were present a goodly number of the working naturalists of the State. At this session the following papers were presented, and are here given in abstract.

THE BLUE QUAIL (CALLIPEPLA SQUAMATA) IN IOWA.

BY PROF. J. E. TODD.

(*Abstract.*)

A specimen of this bird was exhibited, which was shot at Tabor, Iowa, May 20, 1889. The occurrence of this species, which ranges from Texas southward, was connected with the mildness of the past winter, and the great reduction in numbers of the common quail, in southwestern Iowa for the last few years.

IS THE PLUM CURCULIO DOUBLE-BROODED?

BY PROF. C. P. GILLETTE.

(*Abstract*)

In this paper it was concluded that the plum curculio is not wholly or even very largely double-brooded at Ames, Iowa. The more important facts gathered during the past summer bearing upon this subject were:

Egg laying began about the 25th of May and practically ceased by the last of June. Eggs began again to be deposited in considerable numbers about the 20th of July. Unhatched eggs were found constantly from July 22 to August 22. The number of eggs laid after July 20, on trees where counts were made, was over one-fifth as great as the number laid before that date. The beetles reared from early stung plums began appearing in the breeding cages as early as July 22. Beetles were seen pairing July 22. The eggs of the late punctures hatch as well as any and the larvæ develop in the plums.

ON THE DISTRIBUTION OF CERTAIN HEMIPTERA.

BY PROF. HERBERT OSBORN.

(*Abstract.*)

The *Hemiptera* present some instructing cases of special distribution, a few of which are considered. The relation of the distribution to distribution of food plants is discussed and cases cited where there is apparently entire independence of climate, latitude, altitude, etc. For several of the species localities are recorded which extend the range of the species as heretofore known. The species mentioned more particularly are: *Anasa armigera*, *Alydus pilosulus*, *Leptocoris trivittatus* (recorded for eastern Iowa), *Macrocoleus coagulatus*, *Emblethis arenarius*, *Calocoris rapidus*, *Pygolampis pectoralis*, *Melanocaryphus bicrucis*.

ON THE WAX GLANDS OF THE PEMPHIGINÆ.

BY PROF. HERBERT OSBORN.

(*Abstract.*)

After considering the accepted ideas concerning the wax glands of the *Coccidæ* and *Aphidæ*, the paper describes the structure of these glands in *Pemphigus tessellata* Fitch as an illustration of the unicellular form, (apparently the only form hitherto recognized), and in *Schizoneura crataegi* Oestlund, as illustrating a complex gland. In the latter the waxy secretion is forced through chitinous rims to cup like glands, the glands arranged in clusters four to six or seven in a cluster and each composed of numerous cells.

ADDITIONS TO THE CATALOGUE OF IOWA HEMIPTERA.

BY PROF. HERBERT OSBORN,

The additions to my list of two years ago presented in this contribution number thirty and I have a few species undetermined that can probably be included by the time the full list is published.

LIFE HISTORY AND EMBRYOLOGY OF MONOSTEGIA (SELANDRIA) IGNOTIA (NOR).

BY PROF. FREDERICK W. MALLY, M. S.

(*Abstract.*)

This paper was a brief extract, giving the more important results of a study of the above named species as effecting the strawberry, and included in a Thesis prepared for the degree of Master of Science at the Iowa Agricultural College, Ames, Iowa, and is published in Insect Life, Vol. II.

The adults of this new strawberry pest appear about the 1st of April and begin egg deposition soon after. The period of greatest deposition being about the middle of April. In two weeks the eggs hatch. Larvæ are found from the middle of April, being most abundant during the first half of May, and by the 1st of June all the larvæ have matured and entered the earth.

The larvæ of *Monostegia ignota* (*Nor.*), are distinguished from those of *Harpiphorus maculatus* by having a uniform pale brown head, while the latter have one black spot back of each eye and one on the vertex. *M. ignota* is probably single brooded, as none of the larvæ which entered the earth June 1st have pupated, but up to date, September 2d, have only contracted to one-half the length.

Monostegia ignota appears and again disappears about a month earlier than the old pest *H. maculatus* (*Nor.*). The young larvæ, therefore, are plenty before the strawberry plants begin blooming and hence can be easily exterminated by the application of any of the arsenical poisons without the danger of poisoning the berries. These poisons can be effectively applied about the latter part of April or first of May.

THE CRYSTALLINE ROCKS OF MISSOURI.[1]

BY PROF. ERASMUS HAWORTH, PH. D.

(*Abstract.*)

In the May and June numbers American Geologist the writer published a preliminary description and classification of the crystalline rocks of Missouri. Since that time considerable more field work has been done, and much new material gathered which is now being examined in the laboratory. Thus far nothing has been discovered which would originate any new ideas regarding the geology or petrography of the district under discussion, but a great deal of evidence has been obtained confirming views advanced in the publication above mentioned.

The relative ages of the crystalline and sedimentary rocks may now be considered established. The sedimentary rocks are younger than the underlying granites and porphyries. This has been stated by every geologist who has written on the subject, but the evidence, so far as made known, was simply that of super-position. This evidently is not conclusive;

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[1] Read by consent of the Director of the U. S. Geological Survey.

for if the granites and porphyries are eruptives they might be beneath the sedimentary rocks in many places and still be the younger.

The writer observed, in many localities, limestones and sandstones, and conglomerates which had fragments of the crystalline rocks imbedded in them, varying in size from very small to more than two feet in diameter. It is the rule rather than the exception that these fragments are present. There can therefore be no doubt whatever but that the sedimentary rocks are younger than the underlying granites and porphyries. This is all the more interesting on account of the conclusion reached by the Director of the Arkansas State Geological Survey, which had heretofore been counted archæan.[2]

The porphyries and probably the granites of Missouri are unquestionably of eruptive origin. Both the field and petrographical evidence in support of this proposition has been greatly increased since June, 1888.

The interesting relations between the porphyries and granites have been studied in detail in several localities. At present positive statements cannot be made, but it seems probable that the granites and porphyries belong to one and the same eruptive mass. The granite areas are quite small, some of them measuring only a fraction of a mile in diameter while others are three or four miles. The boundaries between the two rocks were traced in different places, and hand specimens carefully taken for petrographic study. All the evidence gathered favors the view advanced above.

In the American Geologist, Vol. I, p. 290-291, the writer has figured certain enlargements of feldspar crystals in the granite, and explained this secondary growth by supposing that the enlargement took place prior to the final consolidation of the magma. Prof. J. W. Judd has done me the honor to reproduce these drawings in the Quarterly Journal of the Geological Society for May, 1889, p. 183, in an article: "On the Growth of Crystals in Igneous Rocks after Consolidation." In this interesting paper Prof. Judd concludes that the crystal enlargements from Missouri belong to the same general class observed in fragmental rocks by different workers, especially by Irving and Van Hise.[3]

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[2] Am. J. Science; (3). 38, 50, July, 1889.

It seems to the writer that the examples produced by Prof. Judd from Mull, in the Western Isles of Scotland, are so dissimilar to the Missouri specimens that it is unsafe to class them together. His is a *Labradorite-andesite* with large porphyritic crystals of labradorite, and a glassy base. The Missouri specimens are from a fairly well crystallized granite; one having idiomorphic crystals, it is true, but which is very far removed from a rock with a glassy base. Judd's idea is that "the growth of crystals of felspar and quartz goes on, at the expense of a more or less vitreous matrix, long after the solidification of the rock," etc.

Neither the field work nor the laboratory work on the Missouri crystalline rocks is completed. The writer will hold himself ready to alter his views on any of the subjects, or to entirely abandon them, should subsequent evidence demand it.

THE NATIVE FOOD FISHES OF IOWA.

BY PROF. SETH E. MEEK, M. S.

(*Abstract.*)

In the waters of Iowa, including the Mississippi River along her eastern border, are found about one hundred species of fishes, of these about thirty-six are usually found in our markets, and are regarded as food fishes of more or less value. About eight of the remaining species are large enough for food, but for various and just reasons, have no market

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[3] See Bull. 8, U. S. G. S. and Am. J. Science, (3). 30. 233, 35.

value. In some the flesh is poor, tough and rank flavored, while in others it is dry, tasteless and full of very small bones. Among such are the shovel-nosed sturgeon, the dog fish, the garpikes, the hickory shad, the skip jack and others never used more than once for food by the same person.

The remaining species are all small, and while directly are of no value, yet indirectly are of much importance. These small fishes, together with the young of all species, furnish much of the food for the large predatory fishes.

In the present paper is given a systematic list of our native food fishes together with a few notes as to their distribution in our waters, their habits and their value as good fishes.

Detailed descriptions of all the fishes enumerated in this paper can be found (1) in Jordan and Gilbert's "Synopsis of the Fishes of North America," published by the Department of the Interior. (2) "Jordan's Manual of Vertebrates of Eastern Uuited States," published by A. C. McClurg & Co. Descriptions and figures of most of them are found in "History of Aquatic Animals," published by the Census Bureau.

Family 1—POLYODONTIDÆ.

2. *Polyodon spathula* Walbaum. Paddle Fish.

This species is known by the prolongation of the long, flat blade which overhangs the broad terminal snout; it inhabits only the larger streams of the Mississippi basin. In this State specimens are occassionally taken from the Cedar River, the Iowa River, the Missouri River and from the Mississippi River. It no doubt inhabits all of the larger streams of the State. Fishermen on the Mississippi River find it more common in the fall and then in bayous. It lives chiefly on small forms of animal life which it stirs up from the mud with its long snout. This remarkable fish attains a length of six feet and is but little esteemed for food.

Family 2—ACIPENSERIDÆ.

2. *Acipenser rubicundus* Le Sueur. Lake Sturgeon, Rock Sturgeon.

This species may be known from the shovel-nosed sturgeon by the presence of spiracles, the sub-conic snout and by the tail which is not depressed nor completely mailed. This species is common in the Mississippi River in the spring, rather scarce at other times of the year. I have no positive record of its being taken in streams within the state, yet it no doubt inhabits them. It reaches a length of six feet and is a fairly good food fish.

Family 3—SILURIDÆ.

3. *Ictalurus furcatus*, Cuv. and Val. Chuckle Headed Cat.

This species may be known by its deeply forked tail, and long anal fin, the latter with thirty-two to thirty-five rays. This species is not common in the state, and is found only in the larger rivers. It reaches a length of two and one-half feet and is the best food fish in the family.

Ictalurus punctatus, Rafinesque. Channel Cat, Silver Cat.

This species differs from the above in having twenty-four to thirty rays in the anal fin. It is common in all the streams and the larger bodies of water in the state. It is larger than the preceding, and as a food fish is not distinguished from it.

4. *Ameiurus nigricans*, Le Sueur.

This species is distinguished from the other *Ameiuri* by having a forked tail, and from the two preceding it can be recognized by its more robust form and darker color. I know of no specimens of this species being taken in this state except from the Mississippi River. It no doubt inhabits the larger streams. This is the largest cat-fish found in the state. Specimens of immense size used to be taken from the Mississippi River, some said to weigh two hundred pounds. At present one is seldom taken reaching a weight of sixty pounds. It is a good food fish though its flesh is rather tough.

5. *Ameiurus natalis*, Le Sueur. Yellow Cat.

The tail is not forked in this species and the following species of the genus. Anal rays twenty-four to twenty-six rays. I have collected but one specimen of this species in the State; it was taken from Indian Creek near Marion. This species attains a length of twelve to fifteen inches. It frequents sluggish streams and still bodies of water. The large head and small body prevents this species as well as the two following from ever being used extensively as a food fish, all rank fairly well as food fishes, especially when not taken from warm stagnant pools.

6 *Ameiurus nebulosus*, Le Sueur. Bull Head, Horn Pout.

Anal rays twenty-two, similar to the preceding. This fish is very tenacious of life. It is common everywhere in the State yet less so than the following. Length twelve inches.

7. *Ameiurus melas*, Rafinesque. Small Black Cat.

Anal rays eighteen to twenty. Found with the preceding from which it not distinguished by fishermen.

8. *Leptops olivaris*, Rafinesque. Mud Cat, Flat Head Cat.

This is the largest of the cat fishes except *A. nigricans* from which it may be distinguished by its flat head and shorter anal fin. Anal rays twelve to fifteen. It inhabits the larger streams of the State and is less common in the Mississippi River than in former years. It reaches a weight of seventy-five pounds, but seldom one is found at present which reaches half this weight. A very good food fish.

Family 4—**CATOSTOMIDÆ.** The Suckers.

9. *Ictiobus cyprinella*, Cuv. and Val. Common Buffalo Fish.

This species may be distinguished from the other buffalo fishes by its thin lips, large terminal mouth, which is protractible forward. It inhabits still water and is seldom found in the river currents. Very common in bayous. It is extensively used as a food fish, though its flesh is rather coarse and full of small bones. It frequently reaches a weight of thirty pounds.

10. *Ictiobus urus*, Agassiz. Razor Backed Buffalo.

Known by the thin lips and the sub-inferior mouth which is protractible downwards. It is very similar to the preceding, and more frequently found in the river current. Length about two and one-half feet.

11. *Ictiobus bubalus*, Rafinesque. Small Mouthed Buffalo.

Lips thick and sucker-like, mouth sub-inferior. Common in Mississippi River, less frequently taken in bayous. It reaches a length of two and one-half feet and is usually more abundant in the market than any of the buffalo fishes.

12. *Cycleptus elongatus*, Le Sueur. Black Horse, Missouri Sucker.

This species is known by the very long head, pointed snout and small eye. Not common, and found only in the larger streams. It reaches a length of two and one-half feet, and is more highly esteemed for food than any other of the suckers.

13. *Catostomus teres*, Mitchell. Common Sucker, White Sucker, Fine Scaled Sucker.

Known from the other suckers by the smaller size of the scales on anterior part of body, sixty-five to seventy scales in lateral line. This is one of the most abundant fishes in Iowa. It reaches a length of one and one-half feet. As a food fish it is of little value.

14. *Erimyzon sucetta*, Lacepede. Chub Sucker.

This is the only sucker found in the State without a lateral line. It is not common in the streams of Iowa. It seldom exceeds a foot in length and is little valued as a food fish.

15. *Minytrema melanops*, Jordan. Striped Sucker.

On each scale is a black spot, these spots forming dark longitudinal stripes. I have found this fish only in Squaw Creek, near Ames, Iowa, and in the bayous near Muscatine. It is not very common and is usually taken in the spring. Too small to be regarded as a good food fish.

16. *Moxostoma duquesnei*, Le Sueur. Common Red Horse, Mullet.

This species may be known by its slender form and the larger scales on the body, about forty-five in the lateral line, pale and silvery. The species is very abundant in the State. It reaches a length of two feet and is not regarded as a valuable food fish. It is found usually in clear water.

Family 5—SALMONIDÆ. The Salmons.

17. *Salvelinus fontinalis*, Mitchill. Brook Trout, Speckled Trout.

On May, 14, 1889, a specimen of this species was taken from Mad Creek, Muscatine, Iowa. I am also informed by Mr. Minott, a well known hunter and fisherman on the Cedar River, that they used to be found frequently in a small tributary of the Cedar River, near Mt. Vernon. At present but few are taken in Iowa and these are stragglers from farther north. I do not know of other salmon being taken in Iowa. As a food fish the brook trout ranks among the very best.

Family 6—ESOCIDÆ. The Pikes.

18. *Esox vermiculatus*, Le Sueur. Little Pickerel.

This species is known from the other pikes of this region by its entirely scaled cheeks and opercles. It is quite common in this State. It attains a length of twelve to fifteen inches. Its flesh is excellent, but its small size makes it a food fish of little importance. "It delights to quietly loiter in the shelter of the pads of the pond-lily and in the shadows of the dense masses of *Potamogeton*, a few inches below the surface of the water. Motionless, in such situations, it awaits the coming of the unwary minnow, when, quicker than thought, it darts upon its prey, and while you look sinks slowly from sight. There is no apparent motion of fin or tail, but ere you realize it, the ravenous beauty is gone. Its coming to the surface is as motionless and unexpected."—*Call.*

19. *Esox lucius*, Linnæus. Pike, Northern Pickerel.

This species is known by the half bare opercles and by being light spotted on a darker back ground. The habits of this species are similar to the preceding. It attains a length of four feet and is one of our very best food fishes. It is a favorite game fish and many are caught each year by anglers in the lakes in this state.

20. *Esox nobilior*, Thompson. Muskallunge.

This species is known by the absence of scales on the lower half of the cheeks and opercles and by being dark spotted on a lighter back ground. The muskallunge reaches a length of six feet and attains a weight of over eighty pounds. It is one of the most voracious of fishes and decidedly gamey. They are found only in small numbers. Specimens are occasionally taken in the Mississippi River. The head of a large specimen taken from the Skunk River, near Ames, is in the Iowa Agricultural College Museum, others are said to have been taken from the same place. This species is not always distinguished from the preceding. It is an excellent food fish.

Family 7—**ANGUILLIDÆ.** The Eels.

21. *Anguilla rostrata*, Le Sueur. Common American Eel.

The common eel is found in all the larger streams of the State, though it is not abundant anywhere. As a food fish it ranks well.

Family 8—**CENTRARCHIDÆ.** The Sun Fishes.

22. *Pomoxis sparoides*, Lacepede. Calico Bass, Grass Bass, Crappie.

This species is very abundant near Muscatine. It is usually called crappie and usually not distinguished from the latter by the fishermen. It can be told from other sun-fishes in this State by the presence of seven or eight dorsal spines and seven anal spines. It reaches a length of twelve inches and is a fairly good food fish.

23. *Pomoxis annularis*, Rafinesque. Crappie, Batchelor, New Light.

Apparently much less abundant than the former, from which it differs chiefly in color and one less dorsal spine.

24. *Ambloplites rupestris*, Rafinesque. Rock Bass, Red Eye, Goggle Eye.

The only sun-fish found in this State with nine dorsal and six anal spines. It is quite common in this State. It attains a length of about twelve inches and is a good food fish.

25. *Chaenobryttus gulosus*, Cuv. and Val. War-Month, Red Eyed Bream.

Similar to the preceding but with three anal spines. It is a very voracious fish, living in sluggish and grassy waters, quite common in bayous along the Mississippi River. I have not seen it elsewhere in the State. Length twelve inches; a good food fish.

26. *Lepomis cyanellus*, Rafinesque. Green Sun Fish.
27. *Lepomis megalotis*, Rafinesque. Long Eared Sun Fish.
28. *Lepomis pallidus*, Mitchill. Blue Sun Fish.
29. *Lepomis gibbosus*, Linnæus. Common Sun Fish, Pumpkinseed.

These four species are found throughout the State, the last being the more abundant. Their flesh is fine but their small size prevents them from being important food fishes.

30. *Micropterus dolomieu*, Lacepede. Small Mouthed Black Bass.
31. *Micropterus salmoides*, Lacepede. Large Mouthed Black Bass, Oswego Bass.

These two species are perhaps our best game fishes. They are found in considerable numbers in the rivers and lakes of the State, one seems about as abundant as the other. They grow about the same size, seldom exceeding a weight of eight pounds. The small mouthed bass is a dull olive green, the young with cross bars. The large mouthed is lighter with usually a broad dark lateral band. As food fishes both are among our best.

Family 9—**PERCIDÆ.** The Perches.

32. *Perca flavescens*, Mitchill. Yellow Perch, Ringed Perch.

This species is quite common in this State especially in some of our northern lakes. It seldom reaches a length of fifteen inches. It is a good game fish. Its small size prevents its being an important food fish.

33. *Stizostedion vitreum.* Wall Eyed Pike, Jack Salmon.

This species is one of our most important food fishes. It is taken in large numbers every year in Spirit Lake and in our larger streams. It is an excellent game fish, reaching a weight of twenty to forty pounds.

34. *Stizostedion canadense*, Smith. Sanger, Sand Pike, Gray Pike.

Similar to the above but smaller, and perhaps less abundant.

Family 10—**SERANIDÆ.** The Sea Basses.

35. *Roccus chysops*, Rafinesque. White Bass. Striped Bass.

This species is not very abundant in the State. It seldom reaches a length of fifteen inches. It possesses some of the qualities of a game fish and as a food fish is not very inferior to the black bass.

Family 11—**SCIENIDÆ.** The Drums.

36. *Aplodinotus grunniens*, Rafinesque. Fresh Water Drum, Croaker.

This species attains a length of two feet or more but is a food fish of inferior quality.

NOTES ON THE NATIVE FOREST TREES OF EASTERN ARKANSAS.

BY PROF. R. ELLSWORTH CALL.

(*Abstract.*)

During the summers of 1888 and 1889 opportunity was presented the writer, in connection with geologic work on the Geological Survey, to study somewhat carefully the tree flora of the region east of the Iron Mountain Railroad and north of the Arkansas River. These original notes, thus made, have been checked by various fragmentary publications, chief of which are those by Prof. Leo Lesquereaux.[*] Prof. F. L. Harvey,[†] Dr. Charles S. Sargent[‡] and Dr. George Englemann.[**]

So far as known to the writer these references contain the only reliable information on the forest regions of eastern Arkansas accessible to the student. The value of the first, great as it unquestionably is, is somewhat lessened by the too general statements pertaining to habitat and, further, by the questionable identification of certain forms.

These causes of error could not well have been avoided, however, since the observations included in the report were made under great limitations of time, having been commenced in the month of October and ended in December. It is understood that neither flower nor fruit was accessible in many instances and thus it happened that on the most trivial general characters alone, plants including trees, were credited to the flora of Arkansas that have not since been seen by any observer. With respect to the other references, little need be said, more than that they are generally quite accurate and afford valuable and reliable information for the State generally. Little, however, can be gleaned from them except in a most general way, respecting the trees of the area limited above. It is hoped to contribute, herein, a little specific information based upon careful and extended observation, particularly of every county from Helena north to the Missouri line and west of the St. Francis River.

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[*] "Recent Botany and General Distribution of the Plants of Arkansas," in Second Report of the Arkansas Geological Survey for the years 1859 and 1860. (Philadelphia 1860), pp. 346–399.

[†] "The Forest Trees of Arkansas," (Cincinnati, 1883, being a reprint from the American Journal of Forestry, for June and July, 1883.

[‡] Tenth Census of the United States, Vol. IX, "The Forest Trees of the United States," (Washington 1884.)

[**] Transactions of the Academy of Natural Science of St. Louis, Vol. III, No. 3, p. 371, *et seq.* (1876), and Vol. III, No. 4, pp. 385 and 589 *et seq*, "About the Oaks of the United States."

Fully four-fifths of the State of Arkansas is still covered with primitive forest. During the last decade only has much been done by the hand of man toward the removal of this vast forest, but so suited appear to be the soils and climatic conditions to the great development of an arboreal flora that even in those regions once practically cleared of the forest there is now a rank growth of the common forms of hardwood trees; the cleared pine areas, too, give promise of future valuable forests. So that Arkansas is still, practically, a forest covered State.

As a whole the State may be divided roughly into two prime areas, the greater of which may be denominated the lowlands. Something more than one-half of the total area of the State will be included in this division. The remaining section comprises the Arkansas portion of the Ozark uplift, which consists of numerous somewhat parallel ranges of high rocky hills or low mountains trending south of westward, and which have a constantly lessening altitude as they are traversed at right angles or toward the south. To the eastward the highland area is limited by the palaeozoic scarp, which may be, for our purposes, indicated by the course of the St. Louis, Iron Mountain & Southern Railroad. The total area above sea level is only about eight hundred square miles or little more than one and one-half per cent, while by far the greater portion of the State will fall below four hundred feet elevation. This higher portion has a large number of interesting trees and shrubs, some of which are peculiar to it, but lying without the area personally examined, is without the proper scope of this paper. Attention may, however, be called to the fact that very many of the lowland trees penetrate far within this hilly country but keep in the main, along the valleys of the larger streams—the Arkansas, the Little Red, the White and the Black Rivers. This is especially true of the cypress, sweet gum, willow-oak, overcup-oak and post-oak.

For the purposes of this sketch eastern Arkansas may be considered a great alluvial plain underlain more or less deeply with deposits of quarternary age overlying—though the quarternary is sometimes wanting—the heavy beds of clays and sands of tertiary age which constitute the chief geologic feature of the area. The soils are generally stiff and clayey, sometimes containing considerable sand and are always cold and wet. That is, the subsoil is a hardpan, often of great thickness, and utterly incapable of complete drainage by either natural channels or artificial methods. The tree flora, therefore responds in character to these physiographic and geologic conditions. A few large and sluggish streams traverse the area among which are the Arkansas, White, Cache, Anguille and St. Francis Rivers. In the bottom swamps of all these streams occur great patches, often miles in extent, of cypress-*Taxodium distichum* Mich., while around the borders of the cypress swamps are found dense growths of hardwoods, among them the willow or water-oak, white-oak, post-oak, black and sweet gum, winged elm, and several forms of *Carya*, notably the shell-bark hickory and pecan.

Within this area the chief topographic feature of importance is Crowley's Ridge, a range of low hills which enters the State from Missouri in the northeast part of Clay County and extends southward, with varying width, to Helena, in Phillips County, a distance of some one hundred and forty-five miles. The geology of the ridge is, briefly, about as follows: Deposits of quaternary age cap it, the lœss being the chief petrographic feature of the southern half. This lacustrine or fluviatile terrane lies directly upon a gravel bed, of varying thickness, which is believed to be correlated properly with the Orange Sand gravels. Following this member are vari-colored cross-bedded, and sometimes indurated, sandstones and clays of tertiary age, the lowest strata yet observed being Eocene in age and belonging to the Claibornian.

These tertiary strata out-crop in the ravines throughout the ridge wherever erosion has removed the quaternary deposits, and also, in a measure, may be seen throughout the ridge at its foot, particularly along the eastern portion of the southern half and the western portion of the northern half. Aside from the lœss deposits the soils of the ridge are noted for the amounts of silicious matter, including sands which they contain, and for the paucity of lime in the form of the carbonate. Except in the case of the pine—*Pinus mitis*—the tree flora does not respond, in any certain measure to this chemic condition of the soil. The ridge is botanically interesting as fostering the growth of a few tree-forms found nowhere else in the State of Arkansas, though abundant in other States in similar and likewise in diverse soils.

Of the *Coniferæ* only the short leaved pine—*Pinus mitis*—and the cypress occur. North of the Arkansas Prof. F. L. Harvey reports the occasional occurrence of the "old-field pine" —*Pinus tæda*—but it is confined mainly to the suitable areas south of that stream and is never conspicuous north. Only the common short leaved form may be seen at any point north of Helena. In connection with this form it may be observed that the distribution of trees in eastern Arkansas is determined more by the general uniformity of soils and topographic features presented than by any marked differences in climatic influences. This species is found mainly, on sandy or gravelly ridges and is confined almost solely to the highest portions of Crowley's ridge, though small areas, as narrow strips, are found along the White River, but mainly south of the latitude of St. Francis County. North of that latitude the pines do not, as a rule, descend to the bottom lands at all. On these highest ridges there is a thin covering of quaternary soils, mixed with varying quantities of tertiary sands and clays. It is, as a whole, a highly silicious soil, of no possible agricultural value when the forests shall have been once removed. Crowning as it does the tops of these highest ridges the pine zone, in this portion of Arkansas, is comprised within a single narrow strip of country, usually not more than one-half to three-fourths of a mile wide, though in Greene and Poinsett Counties the greater width of Crowley's Ridge permits of a series of somewhat parallel ridges the tops of which are often crowned with pines. At such places the zone may widen to two or even three miles.

So great have been the inroads on the pines of this narrow belt that comparatively little of marketable value now remains and that little is difficult of access, being, for the most part, far removed from railroads. The topography of the ridge likewise renders its removal a matter of extreme difficulty, and the slow moving ox team can alone be used to advantage among its steep slopes. But since pine replaces pine in this region a judicious cutting of the intermixed oaks and hickories of the pine belt will, in future years, again render this portion of Arkansas attractive to the commercial lumberer.

Perhaps sufficient has already been said respecting the cypress. Little more may be added than to say that scarcely have the quantities of that timber which have been taken from the swamps of this region sensibly diminished its area. It is found from the Missouri line southward in abandoned channels of the St. Francis and other lesser streams and in the great swamps which are scattered throughout these wet lowlands generally. It penetrates some distance within the palæozoic area of the northwest portion of the State, along the greater water courses, but apparently reaches its maximum development in the White, St. Francis and Arkansas River bottoms.

The cypress is difficult of access in the larger swamps and the supplies for shingle and other uses have been obtained chiefly along their margins. The tree is one of comparatively rapid growth and attention to the laws of forestry will render forever valuable a great portion of eastern Arkansas useful for no other purpose. The species is a light loving tree, that is to say, the crown must have the full force of the light and heat of the sun. No matter then how somber the shadows that enshrine its trunk it will thrive. By one standing on the higher portions of the face of Crowley's Ridge whence a stretch of country full sixty miles in width may be commanded, the cypress patches and zones may be easily distinguished as dark green islets or even belts which tower far above the surrounding forests. The size attained is often very great occasional specimens having been noted by the writer over seven feet in diameter. Aside from the manufacture of shingles the chief use to which the lumber is put is in fence building, for posts, its power of resistance to the action of water being very great.

The tree of present chief value in eastern Arkansas is the white oak—*Quercus alba.* It attains a very great size on Crowley's Ridge and is, beyond question, the largest tree there growing. It extends, also, into the bottom lands of the Anguille and Cache Rivers, on the west. On the east of the ridge, in the bottom land of the lower St. Francis comparatively little white oak occurs, it being there replaced by the "over cup" and "cow oak"—*Quercus lyrata* and *Quercus micheauxii*—together with other less useful forms. Many specimens occur one hundred and thirty to one hundred and forty feet in height and five to six feet in diameter. It once constituted the glory of the eastern forest but the richest areas have been thrice cut over and the most of this valuable timber is gone. The use to which this timber is put is chiefly in the manufacture of staves for whiskey and alcohol barrels, and for export, much of the product being made into barrels, which are then "knocked down" and shipped to Europe. Their use abroad is understood to be for wine and spirit barrels, the close and fine texture of the wood rendering it an especial favorite for this purpose. Large quantities of culled wood of the white oak goes into pork and oil barrels, though the timber of the cow oak is rapidly coming into favor for this purpose. The complete felling of this valuable species is now a question of a very short time and the closeness with the timberer cuts leaves, when coupled with the extremely slow growth of the tree, little hope that a second growth will become available. It is felled with a wanton hand, a comparatively small portion of the tree is utilized—the bark not all—the balance allowed to decay. Stave mills and factories, for both rough and finished products, are found at intervals of a few miles only, along the railroads and away from them, of which the total annual output of staves must run into the millions in numbers.

A very large and beautiful tree of eastern Arkansas is the sweet gum, or *Liquidamber styraciflua*, which abounds throughout the low country. Occasional specimens were noted in the St. Francis bottoms, the diameter of which exceeded six feet, while in Craighead County, trees of five feet diameter were common. This species is probably the most beautiful of the native forest trees of the south. The five-pointed, star-like, leaves, crowding the branches and stems, even to within a few feet of the ground, render its dense foliage of dark green color, which trembles in the breezes somewhat after the manner of the poplar or aspen, peculiarly attractive. The branches of the younger forms are winged after the likeness of the winged elm, but with broader and somewhat thicker alæ. Its wood will sometime become valuable though the degree to which it warps or twists in drying renders it unfit for very many purposes to which its texture admirably adapts it. It is, however, largely used for heavy timbers in barn and house construction, and by manufacturers as a veneer, a large portion of the so-called mahogany furniture being made from this species. The wood takes a high polish and maintains well its position as a rival to cherry.

Two species of forest trees, one of great economic value the other of none, occur on Crowley's Ridge and one of them is found nowhere else in the State. These are the so-called "yellow poplar"—*Liriodendron tulipifera*—and the American beech—*Fagus ferruginea*. The first, the tulip tree, occurs throughout Crowley's Ridge, along its base on either side. Notwithstanding that immense quantities have been removed and sold in northern markets under the name of "poplar" and "yellow poplar" immense quantities are still standing, especially in sections somewhat removed from the railroads. It is a noble tree, often one hundred feet high and with its great trunk extending, frequently with slight variation in diameter and devoid of branches, for forty to sixty feet, is peculiarly valuable for many economic uses. I do not know how or why the tulip tree came to be called a poplar. It is one of the *Magnoliaceæ*, while the poplar proper belongs to the *Salicaceæ*—two families botanically far removed and utterly unlike. But by the name of "poplar" it has long been known in eastern Arkansas and will so be known, probably, so long as sufficiently abundant to attract attention.

The beech, of which no use is made except for firewood, is found on both slopes of Crowley's Ridge and occasionally, though sparingly, on its summit. It attains wonderful proportions equal to those attained by the same species in southern New England and central New York, though this area appears to be quite the limit of its southern distribution in the southwest. A peculiar feature of very many of the larger trees of this form is that all are hollow or if not hollow the heart is dead. Whether this be characteristic also, of the species as it occurs in New England and New York the recollections of my boyhood days are too indefinite to be certain.

These general notes were followed by a register of the species observed in which were given notes on size, abundance, distribution, variations and other facts of observation. The total number of species on which data were obtained were about eighty, the oaks being the most important economically. The botanical relations of the area need a thorough sifting and promise a rich field to whoever shall undertake the study.

ON THE GEOLOGY OF EASTERN ARKANSAS.

BY PROF. R. ELLSWORTH CALL.

(*Abstract.*)

This paper was a continuation and extension of the one presented at the meeting of 1888, and like it was based on the field work done under the auspices of the Arkansas Geological survey. The area studied was much more extensive than that reported on in the preceding year.

The general region examined is all that portion of the State which lies east of the St. Louis, Iron Mountain and Southern Railroad and north of the Arkansas River. The region particularly examined extends from Helena north to the Missouri State line, included a particular study of the geological formations seen in Crowley's Ridge and sought to connect these terranes with those of similar age in other portions of the State. The more obvious facts gleaned during the field investigations are the following:

The eastern half of the State of Arkansas is included within an area which, until comparatively recent geological time, was entirely submerged under a northward extension of the Gulf of Mexico. Reaching away southwestward from near the mouth of the Ohio River, in a nearly direct line, this old gulf found a western limit at the palæozoic escarpment which is approximately, if not exactly, indicated in the state of Arkansas by the railway line above named. From Newport southwards to near Little Rock, the strata composing the oldest series of tertiary rocks—to which series the subjacent strata throughout this area belong—lie uncomformably upon carboniferous shales and sandstones. At and about Little Rock these same strata lie in direct relation to slates of possibly similar geologic age and also to crystalline rocks of uncertain age. Southwestward from the capital of the State to near Arkadelphia and onwards to the State line near Texarkana the strata lie comformably upon rocks of cretaceous age. So gradual is the change in the macroscopic and lithologic characters of the rocks along the Ouachita at Arkadelphia that the line of demarkation between the cretaceous and tertiary cannot possibly be drawn. Here, if anywhere in the State, is to be seen absolute conformity both in stratigraphic and chronologic sequence.

No effort has been made herein to correlate the various subdivisions of the tertiary in this State with the divisions recognized by other observers. Such correlation would be premature, and would be authentic only after very extended and careful observations on the whole tertiary area of the State, while as above noted our observations have been somewhat limited in respect to area. It must suffice to say that the study made shows that the tertiary series included within the scope of this report belong to the eo-lignitic of recent writers and that possibly the Jacksonian group, now considered to attain its most northern extension at Helena, in Phillips County, outcrops in the southwestern portion of Clay County, that is, must be extended northward more than one hundred and forty miles.

One other general conclusion is here deserving of mention, viz: Whatever distinctions or divisions are, in the future, to be recognized within this area must be based upon stratigraphic and petrographic rather than upon palæontologic data. The paucity of fossil remains in all fossiliferous divisions, except in that which is tentatively, herein, denominated the Ostrea bed, and the absolute dearth of such remains in most of the strata lithologically recognized as Eocene tertiary precludes a classification based upon their faunal contents. As has been above indicated the facies of the fauna which has been collected and studied appears to necessitate the correlation of the lowest beds with the Claibornian.

To sum up the stratigraphic or geologic history of Crowley's Ridge and with it that of the region of which it forms a considerable topographic feature it may be said that the ridge is the remains of a former extensive plateau, the western limit of which was the palæozoic scarp of middle Arkansas, as noted above. That erosion occurred from the west, by the waters which are now represented by the White River and other streams, to which, nearly at the northern boundary of the State, the Mississippi added enormous volumes of water, either continuously or periodically. These did their work so completely that the whole of the country between Crowley's Ridge and the palæozoic rocks on the west has been lowered and carried away except where a few unimportant secondary ridges, such as that at Augusta, in Woodruff County, remain to bear witness to the past former height of the whole country. To the eastward the Mississippi was engaged likewise in the work of destruction and denudation, ploughing out an immense trough to which the present Mississippi bed is but the merest pigmy. But while it dug its valley wider it also dug it deeper. Nor has the refilling which for centuries has been occurring yet brought the eastern level up to that west of Crowley's Ridge. During the progress of denudation, the whole southern basin of the Mississippi was slowly sinking, the gulf traveled northwards, until Crowley's Ridge became entirely submerged while the silt laden waters which came slowly flowing from the north deposited their burdens as the great blanket of loess the remains of which caps it throughout nearly its entire length. Then came the time of continental resurrection since which periods the rivers and their tributary creeks and brooks aided by frost, wind and rain, have recommenced the work of destruction, the task of the removal of Crowley's Ridge.

The surface soils of the region are roughly divisible into two groups, each one of which maintains well its chief features in all sections. To the east of the ridge and in the valley of the L'Anguille the surface soil is a rich black loam, such as is usually found on lands subject to overflow and which may stand as the type of the first group. The cultivable soils in the St. Francis-Mississippi bottoms are deeper and richer than any other locality, but they are limited to, comparatively speaking, small areas and these are ridge-like in their distribution. In the L'Anguille bottom the area of black loamy soil is not only a minimum but is also less in depth, rarely exceeding two or three feet at most. This group of soils on both sides of the ridge is remarkably productive, but, since they are in both sections underlaid—generally on the west but only locally so on the east of the ridge—with a limonitic clay or "buckshot" hardpan which in many places comes quite to the surface they have a defective drainage. While these lands produce abundantly certain cereals, such as oats and less abundantly corn, they give but light yields of the staple of the region which in common with all the south is cotton. The yield of this product is usually about one-half bale to the acre.

The ridge soils are the type of group two and are the least adapted for cultivation profitably. They are usually light colored, reddish or yellow predominating, and always more or less sandy, though in many localities they are stiff with abundant clay. Wherever the native dense grasses or other vegetation is removed the soils wash badly and since the slopes of the ridge are precipitous soon very large gullies are formed, which in time grow into extensive ravines or even deep canon-like embayments. Nevertheless these soils yield a fair return to careful husbandry, but are liable to speedy exhaustion, a condition due to the generally prevalent method of farming, a method which does not contemplate rotation of crops as one of its leading principles. These soils will prove permanently valuable only through the greatest. care and a complete change in the methods of culture now in vogue.

To the second group of soils belong, also, all those lands which lie along the slopes of the ridge, on both sides, the western of which are, however, by far the most extensive. These soils are the products of erosion and are largely composed of the lœssian clays which cap the ridge. They are generally mingled with much sand and occasional pebbles from the generally distributed orange sands. They are generally deficient in lime, though this deficiency could be easily remedied by the use of the extensive beds of calcareous marls which are found in some portions of the eastern part of the State, notably in St. Francis County.

With a view to the determination of the value of certain of these soils for agricultural purposes the chemist of the survey, Dr. R. N. Brackett, has made such analyses as are usual in determining the actual value as far as this can be decided by the chemical study of the soil. A chemical analysis in itself, however, does not represent a verdict definitive of the value of a soil for farming purposes. Soils are very complex, the major portions of the elements entering into their constitution are very small in quantities, and their fertility is dependent somewhat on the rate and completeness of the decomposition to which the mineral elements are subject. The analysis then decides nothing as to its agricultural value save within rather narrow limits. But it may decide (a) the absence of some important element or (b) the presence of some element deleterious to plant growth. Analysis of the soils of the region, it may be said generally, show that its cultivable area is composed of a soil containing plant food in fair abundance and in a tolerably soluble condition; that its chief deficiency is lime and available phosphoric acid; that the ridge soils are easily tilled and thrifty when new but possess little durability; that, for the future as now, the best farming lands will be those that lie along the gentle slopes of the ridge. In this brief estimate, of course, the rich alluvium of the overflowed regions is not considered, for from the presence of abundant decomposing and decomposed organic matter, as well as because of constant additions of fine soil from other regions, this quality of land is always fertile and easily tillable.

There are no economic products of a distinctively geologic character to be found in northeastern Arkansas. There are no ores nor are there any deposits of coal. Its abundant lignite is unavailable for fuel, first, because it is a rather poor variety of brown lignite, with much hygroscopic moisture and comparatively little volatile matter and a minimum of fixed carbon, and second, because its stratigraphic relations to overlying and underlying soft clays are such as to render its mining difficult and expensive.

BEGGIATOA ALBA AND THE DYING OF FISH IN IOWA.

BY PROF. L. H. PAMMEL.

(Abstract.)

The secretary of the State Board of Health found fish dying in great numbers at Tama City, Marshalltown and Des Moines. The odor after the removal of ice was very disgusting, partly due to the decomposition of dead fish and other organic matter contained in the water, but also to the growth of a micro-organism. The water below the glucose and starch works at the above places contained large quantities of a greyish gelatinous substance. In microscopical examination this was found to contain large numbers of putrefactive bacteria, but especially common was *Beggiatoa alba*, which is not uncommon on the dead filaments of *algæ* and other decaying organic matter in water. The odor of hydrogen sulphide was very pronounced in the fresh material. After the heavy rains in June the gelatinous masses were washed away and caused little trouble for the rest of the season.[1]

SOME FUNGOUS DISEASES OF FRUIT TREES IN IOWA.

BY PROF. L. H. PAMMEL.

(*Abstract.*)

LEAF BLIGHT OF THE PEAR. ENTOMOSPORIUM MACULATUM LEV.

Last summer while investigating a cotton disease in Texas, Mr. R. D. Blackshaw called my attention to a disease among some of his Le Conte pear trees. This was in the latter part of June, the leaves were falling rapidly and of some all had fallen. Since then new leaves and flowers have been produced. On returning to Ames I found that many of the seedling pear trees in the orchard were affected in a similar way. The disease was especially bad in the nursery. With the exception of some of the Chinese pears every variety in the orchard suffered more or less.

Nearly all of the young trees set out by Captain Speer in the experimental orchard of the experimental station lost most of their foliage prematurely, regardless of variety. The disease is widespread in both Europe and America.[2] In Iowa it has been known for some time as Dr. Halsted writes me, and occurs in different parts of the State. Mr. Beach sent some good material from Atlantic. In this abstract I cannot enter into the development of the fungus and its life history nor is it necessary as that is freely given by authors cited in foot-notes. The spores, however, seem to vary considerably. Mr. Kelsey, a special student in the laboratory, found that a good many leaves were uniformly brown, and that such leaves had an abundance of black pustules independent of the spots, and in these the spores were larger and much better developed than in the pustules found in the spots. The disease is known to occur on several species of *Pyrus*, (*cydonia*, *mespilus*), and on a closely related genus *Catoneaster*. It is quite troublesome at times on the fruit of the quince and pear. It also occurs on the apple (*Pyrus malus*), but is not common. Among a row of seedling pear trees in the college nursery a few apple tree seedlings had accidently gotten in the leaves of these and they were also affected, though the fungus was found on no other trees on the grounds. Experiments with fungicides have not been made on the grounds, but Galloway[3] has recently shown that the application of fungicides at the proper time has proved beneficial.

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[1] The reader is referred to Dr. Kennedy's paper in July Bull. Iowa State Board of Health, 1889, for an extended account. For an account of the life history, Zopf. "Die Spaltpilze," 1884, p. [illegible]; De Bary, "Vorlesungen uber Bacterien," English translation Garnsey and Balfour, p. 7[illegible]; Flugge Mikro-organismen, p. 306, Warming, Om nogle ved; Danmarks Kepter leoende; Bacterier in Vidensk Meddelelser fra d. Naturhst. Forening. Copenhagen, 1875; Farlow Marine Algae of New England, p. 28 and p. 32; Cohn, Beitrage, I Heft 3, p. 157, etc., etc.

A CHERRY DISEASE.

BY PROF. L. H. PAMMEL.

(*Abstract.*)

The past season has been a very severe one on a good many of our cherry trees in the experimental orchards at Ames. Several kinds of parasitic fungi have been especially common.

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[2]—New York; Arthur, Report New York Agricultural Experiment Station, 1884 p 371, and 1885, p. 276. Illinois, F. S. Earl, Prairie Farmer Feb. 12, 1887. New Jersey; Byron D. Halsted. Rural New Yorker. Georgia, New Jersey; B. T. Galloway, Report the Chief of the Section of Vegetable Pathology, 1888, p. 357. Europe; Sorauer, Pflanzen Krankheiten, Second Edition, Vol. II, p. 371. Frank, Die Krankheiten der Pflanzen, Vol. II, p. 590.

[3]—Experiments in the treatment of Pear Leaf Blight and the Apple Powdery Mildew, Circular No. 8, United States Department of Agriculture, Division of Vegetable Pathology.

The "Powdery Mildew," *Podosphæra oxyacanthæ*, has been very destructive to many of the seedlings and the leaves of the young terminal shoots of nearly every variety of cultivated cherry on the ground suffered badly. But far more troublesome than the "Powdery Mildew," is the "Imperfect fungus," *Cylindrosporium padi* Karst. Like the pear disease the leaves fall prematurely, which must very materially lessen the amount of starch stored away for future growth and development and a diminished crop of fruit may be expected. I cannot here give a list of the numerous varieties which suffer from it and those which do not. It will be sufficient to state that a large number of varieties on the grounds lost their foliage by the middle of August, while others lost only a small proportion. Scarcely a variety is wholly exempt. The mahaleb had the best foliage, being attacked only to a slight degree and usually only on the lower leaves by this fungus, while it was entirely free from *Podosphæra oxyacanthæ*. The disease is very wide spread in this country, while in Europe it appears to cause little trouble judging from the meager account found in European works. Prof. Budd informs me he has been familiar with it for many years and has noticed it especially troublesome on the Early Richmond, Mr. Beach found it on the mahaleb at Atlantic, while Mr. J. S. Harris reports it from La Crescent, Minn. Mr. Ellis[4] has distributed it from New Jersey. Prof. Arthur[5] found it very troublesome in New York and in his report has given quite a full account of it. Kellerman[6] has distributed it from Kentucky. Mr. T. T. Lyon[7] finds it occurs on the following hosts: *Prunus domestica*, *P. padus*, *P. cerasus*, *P. americana*, *P. armeniaca*, *P. persica*, *P. serotina*. At Ames it has been found most commonly on the cultivated cherry. Mr. Morris, a special student at the laboratory, found it on the apricot, though only on a few leaves. Little seems to have been written about this fungus. Prof. Arthur gave considerable attention to it but it was first described by Karsten,[8] but I find few European references. Prof. Peck[9] described the fungus as *Septoria cerasina*. Some specimens of the Iowa fungus were sent to Mr. Ellis who writes that he compared it with Karsten's *Cylindrosporium padi* with which it agrees and that 1609 of his distribution is apparently the same thing. The specimens on plum collected by Arthur are certainly like the form on cherry only our specimens seem to be a little more vigorous. Arthur[10] considers *Septoria pruni* Ellis, to be a synonym of *S. cerasina*. They are certainly much alike and I think it is safer to refer these *Septoriæ* to *Cylindrosporium padi* Karst.

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[4] North American Fungi, Series II, Cent. XXIII, No. 2281.

[5] New York Agricultural Experiment Station, 1886, p. 293. and 1887, pp 347, 350.

[6] North American Fungi, No. 1151.

[7] Michigan Horticulturist, Vol 1, 1836, p. 134.

The fungus may be briefly characterized as follows: Dull or red spots make their appearance on the upper surface of the leaves in June and July, later these become brownish, and on examination of the under surface of the leaf a yellowish pustule is readily distinguished. When mature, the epidermal cells become ruptured and a large number of colorless one-celled spores issue. The spores are borne on colorless vertical threads, and usually collect in whitish patches near the pustule. It is easily recognized by this character.

Prof. Arthur considers this fungus to be connected with an ascosporic form, which he has not named. A more detailed account of this stage was given in his Sixth Report. The conidia do not germinate readily, several media were tried but all proved unsuccessful. The leaves on the terminal shoots are usually affected worse than any of the others. In mahaleb the lower leaves on lateral branches are spotted and diseased.

8—Karsten, Sym. Myc., Ferm. XV p. 150. Saccardo, Sylloge, Fungorum III. p. 738. Sorauer, Pflanzen Krankheiten, Second Edition, Vol. II, p. 424 Roumeguere, Fungi Europaei præcipue Galliæ exsiccati Revue Mycologique, 1888, p. 15.

9—Twenty-Ninth Report New York State Museum of Natural History, p. 48.

10—Loc. cit., 1885, p. 297.

NEMATOCYSTS.

BY PROF. C. C. NUTTING, M. S.

(Abstract)

Nematocysts or cnidocells or "stinging cells" as they have been variously called, are found in many *Cœlenterates* and some *Planarians*.

Three types occur in *Hydræ*, namely: First, small pear-shaped; second, small oval with long thread; third, flask-shaped with barbs, the latter occuring also in *Millepora* and known as the *hydroid* type.

In *Physalia arethusa* they are found in bead-like purple bodies which are arranged along the locomotor tentacles and curled around them when retracted. These tentacles are homologous with the "fighting *Hydræ*" of *Hydromedusæ*. The nematocysts are 1ound, purple and project a crimped thread.

Very complicated nematocysts occur in certain corals, notably *Isophyllia dipsacia* where they are found packed along one side of tentacles which protrude from the mouth of the coral. These large and complicated nematocysts were described and experiments and observations regarding them related.

The use of these cells was discussed, and the testimony of Agassiz, Dana, Tarr and Gosse to the fact that the thread penetrated the substances attacked, was given.

The testimony of Lewes and observations of the author were given in opposition to the views of those who upheld that penetration was necessary to effective use of nematocysts. The author stated that the nematocysts of *Physalia* could act or at least produce irritation long after they had been completely dried and presumably incapable of projecting their threads.

The author held that "water fleas" when coming in contact with the tentacles of *Hydræ* were seldom killed or even paralyzed for any length of time and that they often acted in the same way when touched by any unfamiliar object. The difficulty of provoking a discharge of nematocysts by mechanical stimulus was mentioned and experiments and observations on living corals related.

The author denied that the threads were projected with lightning-like rapidity, as stated by Agassiz and others.

The manner of projection was discussed at some length, and it was considered probable that it was by partial eversion.

The mechanism of these cells was touched upon as offering interesting mechanical problems not yet solved.

The nematocysts are thought to originate in the nucleus of ectodermal cells, and the author thought that several sometimes originated in one cell.

The apparent absence of nematocysts in *Gorgonidæ* was announced and the systematic importance of this fact insisted upon.

(The paper was illustrated by sketches by the author.)

THE FERNS OF MUSCATINE COUNTY, IOWA.

BY. PROF. F. M. WITTER.

(*Abstract.*)

The following ferns have been noted or collected by me in Muscatine County. They are included in thirteen genera and twenty species:

Adiantum pedatum, *Aspidium achrosticoides*, *Aspidium goldianum*,* *Aspidium thelypteris*, *Aspidium spinulosum*, *Asplenium felix-fœmina*, *Asplenium angustifolium*, *Asplenium the-*

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* The correctness of this determination is somewhat questionable.—EDITOR.

lypteroides, *Botrychium virginicum*, *Camptosorus rhizophyllus*, *Cystopteris bulbifera*, *Cystopteris fragilis*, *Onoclea sensibilis*, *Osmunda claytoniana*, *Osmunda cinnamomea*, *Phegopteris hexagonoptera*, *Polypodium vulgare*, *Pteris aquilina*, *Pellæa atropurpurea*, *Woodsia obtusa*.

PEARL BEARING UNIOS.

BY PROF. F. M. WITTER.

(*No Abstract.*)

NOTES ON A FOSSIL WOOD FROM THE KEOKUK LIMESTONE, KEOKUK, IOWA.

BY PROF. C. H. GORDON.

(*Abstract.*)

Some years since a portion of supposed fossil wood was obtained from an eighteen inch limestone layer about six or eight feet below the Geode bed. It was secured by Mr. S. J. Wallace and placed in the rooms of the Keokuk Library Association. A brief mention was made of it in a letter to the editors of the *American Journal of Science and Arts*, as noted in the May issue of 1878.

It consists of a "section about three feet long, one end of which disappears in the bank and the other apparently taken off in quarrying years before. It is flattened into a thin coaly layer one-sixteenth to one-sixth of an inch thick and twelve inches across, and seems to be separated by pressure into two parts apparently not quite on the same plane." The flattened layer of carbonaceous matter has largely disappeared though enough remains to show its nature, and the cast of the woody fiber in the limestone is well marked.

At one place a leaf scar is quite clearly defined and at others small transverse ridges probably due to pressure. It shows coarsely the costate structure of *Sigillaria*. The arrangement of the areoles cannot be made out though probably distant and not continuous. As stated by Lesquereux the decorticated layers are of little if any specific value, but the fact that, so far as we can learn, this formation has thus far proven destitute of land plants gives this example peculiar interest and on this account a name may prove serviceable. We therefore designate it *Sigillaria wallacii*, in honor of its finder.

GEOLOGICAL HORIZON AND LOCALITY.

From the Keokuk limestone six or eight feet below the base of the Geode bed; found in the bluff just below the Keokuk and Des Moines depot, Keokuk, Iowa.

ON THE KEOKUK BEDS AND THEIR CONTAINED FOSSILS IN THE VICINITY OF KEOKUK, IOWA.

BY PROF. C. H. GORDON.

(*Abstract.*)

AREA AND THICKNESS.

Outside the region covered by this paper, the most notable exposure of this formation occurs at Crawfordsville, Indiana, where its thickness is said to be two hundred and eighty feet. [1]

South of the Iowa line, exposures occur along the Mississippi in limited areas, and southwestward in Missouri, yielding most of the lead mined in that region.

At Keokuk it consists of two well defined divisions—the lower or Calcareous and the upper or Geode division. The Calcareous division consists of forty to sixty feet of limestone in varying layers, with clay or shale partings one to six inches thick. About the middle of this division occurs a pure massive layer termed the "white ledge" which furnished the stone for the noted Mormon temple at Nauvoo. Some of these layers abound in chert.

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[1] —American Geologist, Vol. II, p. 407.

The upper division or Geode bed consists principally of argillaceous shale through which the geodes are more or less thickly disseminated. Below it is more calcareous and contains the largest geodes.

II. GEODE BED.

11. Fine, blue sandy layer. Rarely found. Seventeen species. *Poteriocrinidæ*. *Batocrinus lagunculus* Hall............................5 inches

10. Soft gritty shale that decomposes readily. Filled with geodes from size of marble to four inches in diameter..............................15 feet

9. Shale, more calcareous. Geodes larger; occasional bands of limestone........................20 feet

I. CALCAREOUS DIVISION.

8. Limestone, hard in thin variable layers......... 2 feet

7. Shale, argillaceous........................... 2 feet

6. Limestone; layers thin and cherty below. *Dorycrinus* bed at top containing *D. mississippiensis* Rœmer; *Batocrinus nashvillæ* Troost; *B. biturbinatus* Hall; *Agaricocrinus wortheni* Hall; *Barrycrinus tumidus* Hall; *Archimedes oweniana* Hall; and other forms................. 5 feet

5. Blue, sub-crystalline limestone in layers six to twelve inches thick alternating with similar layers of shale. Shell bed; notably *Spirifer keokuk* Hall; *Orthis keokuk* Hall; and fish teeth. The upper part is termed the upper fish bed.. 9 feet

4. Limestone, massive, white, sub-crystalline. Occasional fish teeth and spines. Termed the white ledge............................. 4 feet

3. Shale, hard, calcareous, approaching a rotten limestone. Occasional bands of chert. Pockets of calcite. *Actinocrinus*, *Agaricocrinus*, *Barrycrinus magister* Hall. The layer containing crinoids is not persistent. It occurs in the upper part and usually associated with reniform or lenticular masses of chert; called the rolyboly bed......... .... 6 feet

2. Blue or drab, sub-crystalline limestone, massive. Good quarry rock. Lower crinoid bed above. *Agaricocrinus* with shallow concavity. *A.* with sixteen arms. *Actinocrinus pernodosus* Hall. Stems and plates of *Eucladocrinus* below. Fish remains.................................. 3 feet
1. Limestone in thin layers. Cherty. Lower fish bed. *Platyceras fissurella* Hall. *Platyceras equieatera* Hall.................................. 6 feet

No. 1 is but partially exposed here, its full thickness probably aggregating twenty feet.

CORRELATION.

The uppermost layer, No. 11, was discovered at a single locality by Mr. L. A. Cox. In its lithological character as well as its fossil remains, it very much resembles the crinoid beds of Crawfordsville. The most common forms in the calcareous division at Keokuk are wanting at Crawfordsville. We are disposed to consider the lower part of those beds consisting of twenty-five feet of shale as the equivalent of the goede bed at Keokuk.

FOSSILS.

The crinoids, the most prominent form, though not the most numerous. One-half the Keokuk forms appear at Keokuk and about one-fourth at Crawfordsville.

Brachipods numerous, *Spirifera* and *Productidæ* predominating. Most interesting collections of crinoids made by Mr. L. A. Cox and Mr. N. K. Burket.

OBSERVATIONS ON THE KEOKUK SPECIES OF AGARICOCRINUS.

BY PROF. C. H. GORDON.

(*Abstract.*)

Six species of *Agaricocrinus* obtained from the Keokuk beds, of which three, viz: *A. americanus* Rœmer; *A.*

whitfieldi Hall; and *A. wortheni* Hall, occur at Keokuk. *A. americanus* and *A. wortheni* apparently well distinguished. The latter apparently the culmination of this generic form which becomes extinct at the close of this period.

A. americanus presents many differences of structure. Species sadly in need of revision. Forms before us have very shallow concavity not "deeply concave" as defined by Wachsmuth and Springer;* allied to *A. whitfieldi* in having the secondary radial of one of the posterior rays unequally quadrangular, while the other has its upper acute angle truncated by one of the interradial plates. Arms regularly twelve in number. Found in the lower crinoid beds.

Specimens of this subexcavate form in collections of N. K. Burket, L. A. Cox and the writer.

The sixteen armed forms of *A. americanus* present persistent characters that may be sufficient to entitle them to more than varietal distinction. Arrangement of arms generally according to common plan. Basal concavity exceptionally deep, involving the whole series of radials up to and partially including the secondary radials. Nearly all examples with sixteen arms derived from the lower crinoid beds, associated with the subexcavate form above noticed.

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* Revision Palæocrinoidea, Part II, p. 109.

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